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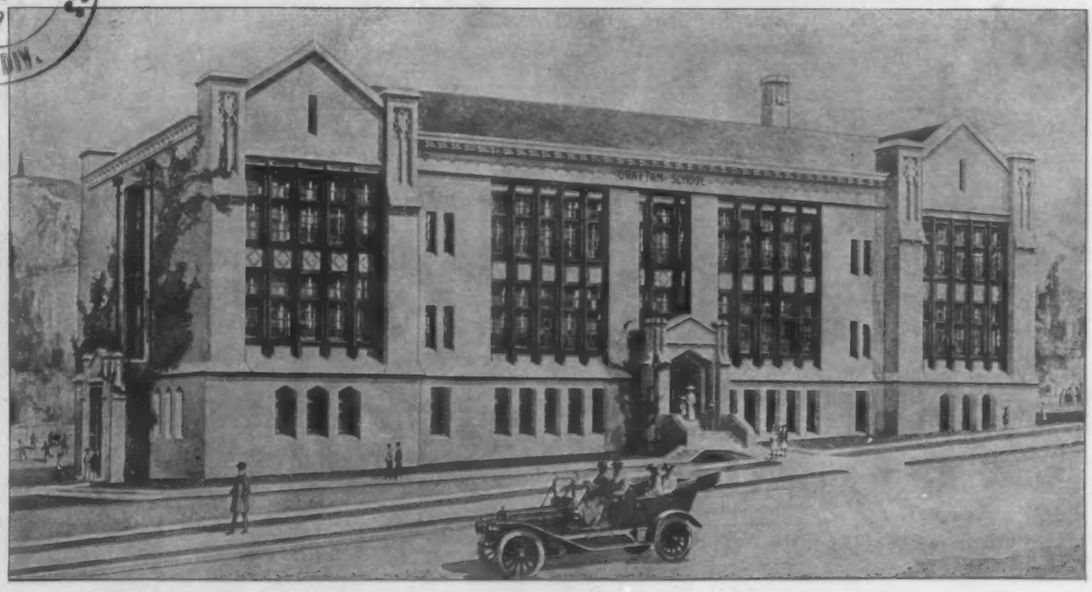

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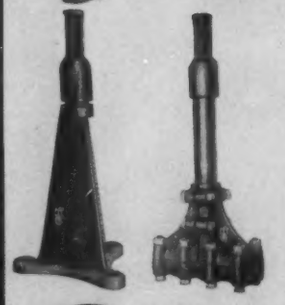

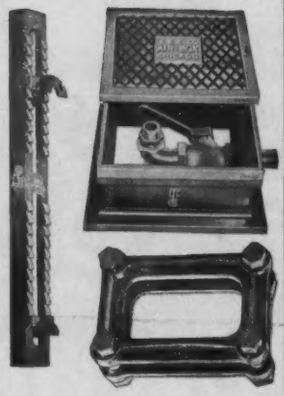

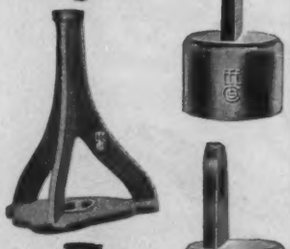
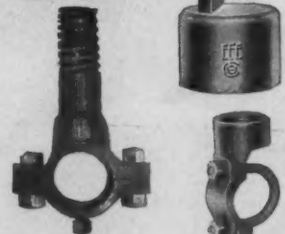

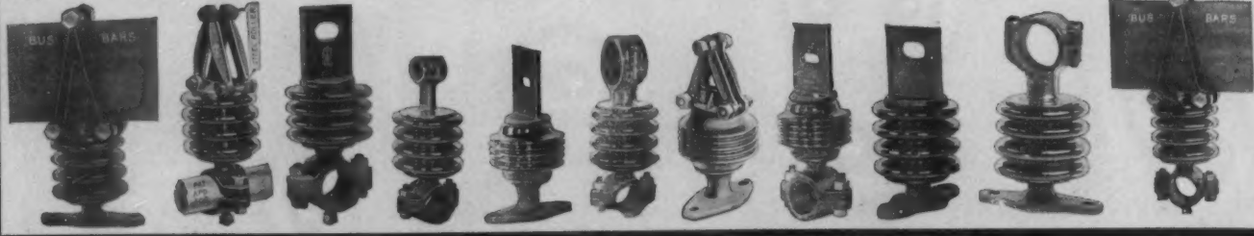

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General View of Coleman Power House and Pipe Line.

THE COLEMAN PLANT

By Rudolph W. Van Norden
Member A. I. E. E., A. S. C. E.

OF the plants which have been built by the Northern California Power Company, the Coleman division is the fifth and largest. It is interesting from the manner in which many problems of construction have been treated, and represents the most advanced ideas for high efficiency in operation and maintenance, together with the utmost economy in construction compatible with good design and work. It will perhaps assist the reader in comprehending the manner in which the development has taken place by giving a short description of the system.

Two watersheds are employed, the one being Battle Creek, and the other Old Cow Creek. On the former are situated four of the plants: Volta, South, Inskip and Coleman. On the latter watershed is situated the Kilarc plant. Water is first diverted from the north fork of Battle Creek, and this supply is augmented by many springs in the country north of this stream. This water is carried through a series of earth ditches to a point near Shingletown, where a fall of 1200 ft. serves the Volta power house, the first plant which the company built, and which has a capacity of 8500 horsepower. From this point water is conveyed in open canal, crossing the north fork of Battle Creek, where additional supply is added, following the con-

Diverting Dam and Intake, South Battle Creek.
Intake and Water Gate Below Diverting Dam.
Typical Waste Weir.
Section of Canal in Rock.
Headgate and Siphon No. 1, Waste Gate on Left.

tour of the country and joining with another canal which brings water from a diversion in the south fork of Battle Creek. This combined flow is utilized in the South power house which is situated on South Battle Creek with a capacity of 5400 horsepower. From this plant the flow is again diverted into a canal which follows the north bank of South Battle Creek for a distance of five miles, passing en route through a number of tunnels, to the Inskip plant, which is also situated on South Battle Creek and from which is delivered 8000 horsepower.

After passing through this plant the water is again diverted into the new Coleman canal and is carried for a distance of 10½ miles, crossing North Battle Creek and several smaller creeks, each of which adds its quota of water. This canal delivers water to the new Coleman plant, and thence discharges into main Battle Creek.

The development of this system is a consummation of plans which were made over ten years ago, but there was little idea then that the entire development could be carried out or that there would be a market for this power within so few years. The construction progress has, however, been the result of a constantly growing demand for power which has been apparent almost as soon as each of the various plants have been finished. In the new plant the attempt has been made to design an installation entirely modern in electrical and mechanical equipment and so arranged as to afford the highest operating efficiency, both from the point of operating costs, low depreciation and high grade service at absolutely the minimum cost of installation. All materials entering into the construction have been of the highest grade and every device has been employed, without extravagance, for safety. The construction has been performed entirely by the company's force and the closest attention has been given to every detail of the work by those in authority.

Canal.

The canal is similar in design and construction to other canals on this system, and in fact, follows closely old California mountain practice. Water is diverted about one-eighth mile below the Inskip power house by a dam across South Battle Creek. This dam is of rubble masonry construction, 15 ft. high, having a gravity section with an Ogee face. While the entire length of the dam has this section and can be used as a wier, there is a space 50 ft. long in the center which is slightly lower than the rest of the crest, which under ordinary circumstances would carry the overflow. At the north end of the dam is a rubble stone wall perpendicular to its axis and forming the outer wall of the canal. It extends above the dam for 50 ft. and then is turned into the bank, two large intake openings admitting the flow into the canal.

This wall extends below the dam about 300 ft. and terminates in two main gates which control the flow into the canal. The design of these gates follows the practice used throughout the system, being constructed of heavy timber, bolted to the rear of which are iron strips, bearing against rollers. This arrange-

ment makes the movement of the gates comparatively an easy matter. They are raised and lowered by means of a steel rack and pinion gear. Between the two gates, and on either side are abutments between which the gate frames are mounted. Immediately joining the gates, and in the canal wall are a pair of waste gates, which may be opened to return the flow to the river should it be necessary to make repairs on the canal.

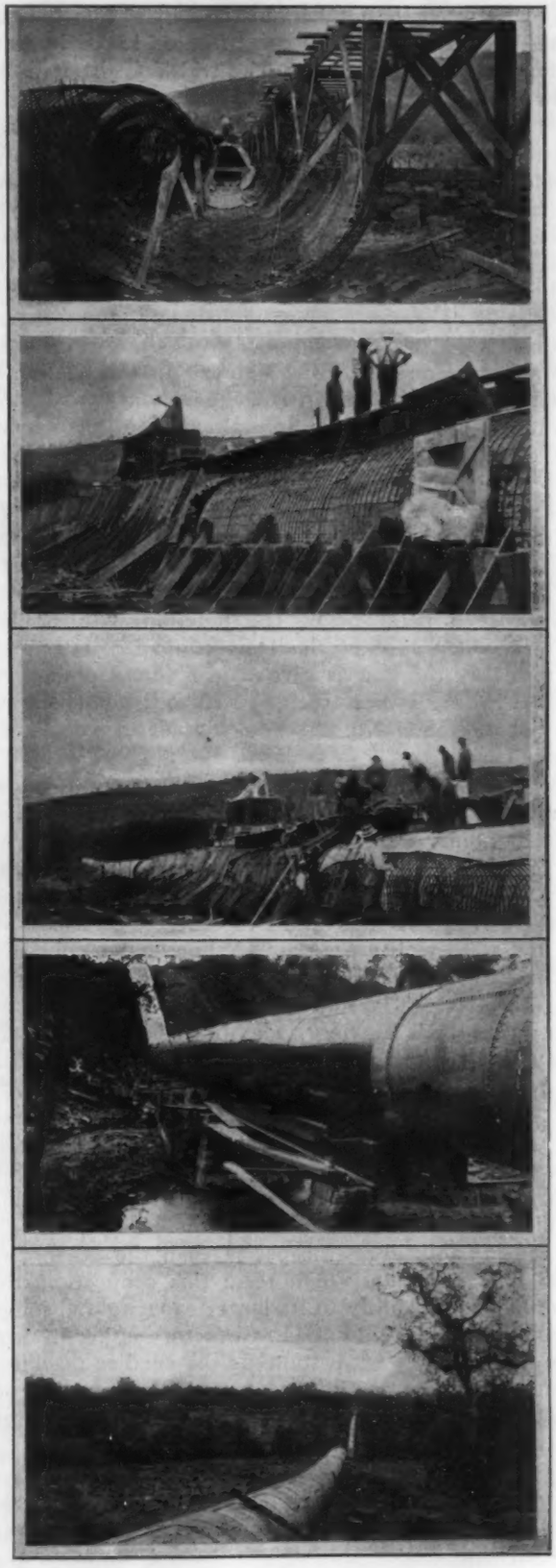
The canal now winds its way along the side hill about two miles to the first inverted siphon. The country traversed is rolling and more or less rocky, the ground being largely boulders, cemented by igneous action, having a hardness almost equal to solid rock formation. There are many places on the canal line where solid rock was encountered and in some of these the work was not only very difficult but the greatest care was exercised in order that the outside wall of the canal would not be shattered. In this section is the only tunnel. It has a length of 367 ft., a width of 12 ft., and a height of 9 ft., and it is unlined.

The first siphon crosses the north fork of Battle Creek. It is riveted steel pipe ¼ in. thick and having a length of 1270 ft. The inside diameter is 76 in. and the greatest head on the pipe is 80 ft. At the creek crossing the pipe is carried on rubble masonry piers, the central 50 ft. span, being supported on a Howe truss bridge. The entrance of this siphon likewise has its equipment of a pair of sluice gates and a pair of waste gates. This siphon terminates in a large block of concrete which acts as a header for a continuation of the canal.

The canal now continues for a distance of 1000 ft. and entrance is made to the second siphon. This siphon is one of the particularly interesting engineering features of this work. It has a total length of 3557 ft. The greatest head is 115 ft. The greatest head on the concrete section is 46 ft. For the first 1815 ft. it is of reinforced concrete with an inside diameter of 87 in. The thickness of concrete at the bottom is 7 in. and 5 in. at the top. Concrete pipe, while perhaps costing more than steel pipe, will have a much greater life.

The pipe is made in wooden forms, both inside and out. It is reinforced with one layer of triangle mesh fabric, the weight of the fabric being varied in proportion to the head on the siphon, to get a safety factor of two without reference to the strength of concrete. For stiffening a longitudinal strip is placed along the top and also the bottom of the pipe. Between the concrete and steel sections is an expansion joint inclosed in a block of concrete 10 ft. square, and having a depth of 12 ft. A complete crushing and mixing plant was erected convenient to the pipe.

The steel section has a minimum inside diameter of 86 in. and a thickness of ¼ in. At the lowest point, where it crosses Baldwin Creek, this siphon, like the first one, is supported on rubble masonry piers, and the longest span is carried on 15 in. I beams. This crossing is not as difficult or extensive as that of the first. From the outlet of siphon No. 2 there is no interruption in the canal until the forebay is reached.



Commencing a Section of Concrete Pipe.
Building Concrete Pipe.
Crushing Plant and Finished Pipe in Place.
Steel Section Crossing Baldwin Creek.
Entire Siphon, Concrete Section in Distance.

Between the intake and the first siphon the canal has a capacity of 325 second feet or 13,000 hydraulic miners' inches of water. The width at the bottom is 11 ft. and the depth of water 5½ ft.

As the canal is not lined throughout, there is no attempt to maintain any predetermined slant to the sides. In fact, the material at almost all points is such that the sides are practically vertical. At a few places where there might be danger of the side wall falling in, a dry rubble wall has been built to form a sort of rip-rap. Below the outlet of the second siphon the canal has a greater capacity than at the entrance, as considerable water is supplied from the several creeks which are crossed by the siphon. In this section the canal has a width of 16 ft. on the bottom; the depth of water is 6½ ft. and the normal capacity is 500 second ft. or 20,000 hydraulic miners' inches of water.

The water supply from the small streams is added as follows: A small masonry dam in North Battle Creek diverts the flow into a canal, which carries the water two miles, and delivers it into Darrah Creek. This water with that of Darrah Creek flows down the creek to a point below the junction with Baldwin Creek, when another small diverting dam is reached. From here the flow is carried in a semi-circular steel flume having a diameter of 10 ft. to a point near the outlet of siphon No. 2, where it is delivered into the main canal.

The 9 spillways throughout the length of the canal are constructed of rubble masonry. Six of them are at points where the canal crosses small canyons or gulches. In construction, a masonry wall is built across the gulch acting as the outer wall of the canal. At the bottom of this wall is a concrete sand box and in the wall itself are a pair of sluice gates consisting of cast iron plates on brass bearing guides. The openings are 30 x 30 in. and are operated by a screw and nut in a bronze bearing. The dimensions of the spillways are: length 140 ft.; crest above bottom of ditch 8 ft.

The canal was excavated throughout by means of steam shovels, four shovels being used at times. Two were No. 49 Marion ¾ yard rock dipper, 25 ft. boom and 14 ft. dipper sticks, one was a model 30 Vulcan, and one a No. 60C Bucyrus. The latter is of a considerably greater capacity than the other three and it is interesting to note in this connection, that due in all probability to its larger capacity and longer boom, its work was not as satisfactory either in economy or speed of excavation, as the smaller machines. Under the best conditions of work, it was observed that one Marion shovel working on a day and night shift could excavate 615 yards per day.

In excavating the canal the first operation was to drill three, but more generally, four holes abreast and to the bottom of the cut. These holes were drilled with 2¼ in. Burleigh drills, and the rows were spaced about 8 ft. apart. The amount of explosive in loading was determined from the nature of the drilling. The explosive used was 40% giant, 20% stumping powder and black powder. The holes on the lower side of the canal were invariably loaded lighter than those on the upper side, to prevent shattering the outer wall. From 20 to 26 holes were fired from a battery to a round.

After the shovels it was necessary to clean and trim the cut. This was done with the derricks, mounted on the lower bank. There were eight of these derricks, two being driven by electric motors, and six with air driven hoists. With each derrick was a complement of about 14 men, whose principal work was to load skips by hand. These skips are hoisted out of the cut and dumped over the outer bank.

The steam shovels, as well as the hoists already mentioned, were operated by compressed air. This was supplied wherever necessary from 4 in. mains, laid on the ground along the line of canal. Air was delivered directly into the boilers on the shovels.

Forebay Reservoir Excavation, Penstock Intake in Middle Distance.

Cleaning and Trimming Canal Excavation Following Steam Shovel.

This was found to be more economical than using fuel hauled over mountain roads from 15 to 25 miles. On the other hand, electric power to drive the compressors, being surplus power, cost practically nothing. There were four compressor plants, one near Siphon No. 2, one about one-half way down the canal, one about three-quarters of the distance, and the last one at the boiler shop between the forebay and power house. These compressor plants were naturally temporary affairs, although the foundations for the machines in all cases were well constructed of concrete. The largest of these plants, which was the second named, was equipped with six compressors as follows:

1 Ingersoll-Sargent two stage compressor, capacity 550 c.f.m. driven by a 150 h.p., 2000 volt G. E. motor.

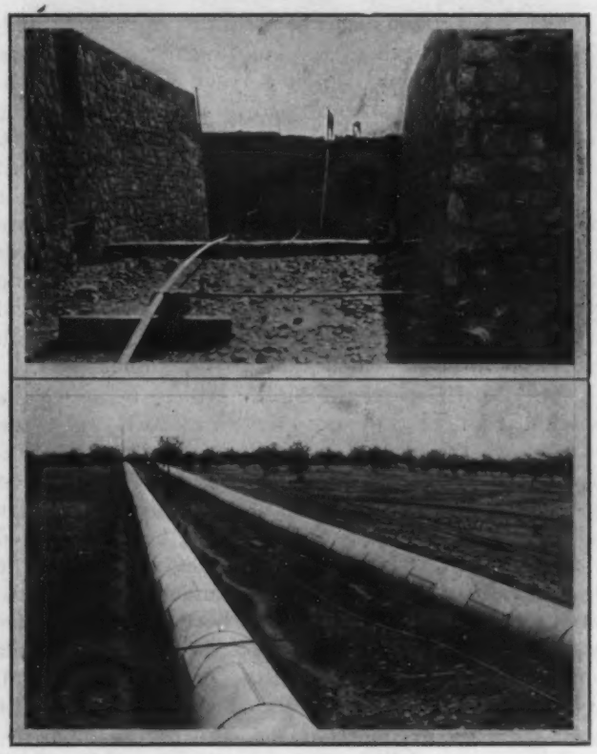
1. Ingersoll-Sargent 420 c.f.m. compressor, and 1 Laidlaw-Dunn-Gordon 240 c.f.m. compressor, both being driven from a common shaft by a 150 h.p., 440 volt G. E. motor.

2 single stage Giant compressors, capacity 220 c.f.m., driven by 50 h.p. Bullock motors.

1 two stage Laidlaw-Dunn compressor, capacity 880 c.f.m., driven by a 200 h.p., 2000 volt Form M, G. E. motor.

The other compressor camps were more or less similar in equipment to this camp, but in no case of as great a capacity. In some cases it was necessary to pump water a distance of several miles from Battle Creek to supply the camps and compressors. A transmission line was built early in the work from Inskip power house to Coleman. This line was tapped wherever necessary to deliver 6600 volt, 3-phase current. Eventually this line will be used for 66,000 volt transmission.

The canal terminates at the forebay which consists mainly of two wing walls thrown up by excavation with a steam shovel. These walls flare out from



Penstock Intake.
Six-foot Pressure Pipes.

the penstock which is of rubble masonry. The penstock has a straight section 17 ft. wide in which are placed the main submerged sluice gates, each having an opening 6 ft. high and 8 ft. wide. The water, however, has a depth of 18 ft. Beyond these gates the penstock walls diverge until the width between them is 50 ft. Entering the front wall are the two main pipe lines. The ends of these pipes are flared where they pass through the wall, and are given an elliptical section.

There will be no screens in this penstock, but in the canal before it empties into the forebay will be placed a set of grizzlies, and a waste gate and sand box. The grizzlies are built up of 2¼ in. x ½ in. steel bars, spaced 2 in. apart. They are mounted in a frame of railroad iron, and set in inclined position in masonry walls.

Pipe Lines.

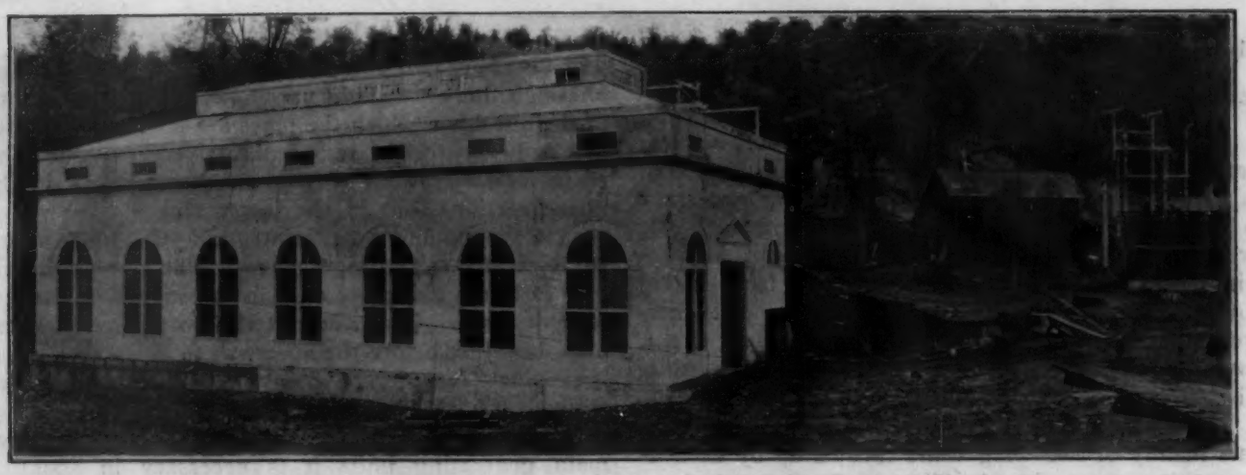
There are two pipe lines laid parallel to each other, although there are slight variations due to the contour of the hill down which the pipes are laid. These pipes are built of steel plates, double riveted on the long seams and single riveted on the round seams in the upper sections, but in the lower sections the round seams are double butt joints, and the long seams triple riveted. The pipes have a diameter at the tip of 6 ft. and a thickness of ¼ of an inch. This tapers to a diameter of 5 ft. and at the bottom a thickness of ½ in. Just before the approach to the power house both pipes, in order to maintain an even grade, pass through tunnels, one being about 100 ft. and the other 400 ft. long. This plant being equipped with three main generating units it is necessary in adopting two pipe lines to make a third connection common to each. This was done by placing a saddle on each pipe, the connections from which converge to a steel Y. In each of the pipes beyond the saddle is a 48 in. hydraulically operated gate valve. In each of the converging pipes for the three units and just before they reach the Y there is placed a 48 in. gate valve similar to the others. Beyond the gate valves of the two main pipes and also the Y of the third pipe direct connection is made horizontally under the level of the power house floor to the water wheels. A pipe connection to supply the exciters is taken from each of the converging pipes already mentioned through saddles placed on these pipes. Each of these connections is a pipe 12 in, in diameter and each after passing through outside steel screw stem operated gate valves join in a T connection from which is taken a common pipe 12 in. in diameter. This also passes under the power house floor and is carried through a Y branch to the exciter water wheels. The station water supply system supplying water for various purposes in the building and about the grounds is taken from this exciter pipe and the desired pressure is obtained by passing the water through a pressure regulator.

The main gates are operated by the main water pressure on the operating pistons, and is controlled by means of four way valves. These gates were designed by Allis-Chalmers Co. and built by Crane & Co.

The total length of the main pipe lines is 3600 ft. The total fall from the surface of the reservoir when full to the surface of the tail water at the power house is 487.53 ft.

Power House.

The power house is situated at the edge of the incline about 300 ft. back from Battle Creek. This was done to shorten the pipe lines as much as possible and also to provide for a receiving pond at the lowest possible level, to give draft for the water wheels. The power house is a steel frame structure, mounted on a solid block of concrete, as a foundation both to the building and the machinery. The foundations are carried down to a stratum of sandstone, which is slightly below the level of the bottom of the draft tubes. A tunnel 12 ft. wide and 9 ft. deep runs throughout the length of the building directly in the rear of the machine foundations. This tunnel, described later, is used for the various systems of pipings



Power House, Pipe Line and Arrester House During Construction.

and for oil tanks, etc. The length of the building is 118 ft. and the width 59 ft. It is arranged in two bays. In the main bay having a width of 35 ft. is placed all of the generating machinery. In the other bay is placed the low and high tension switching apparatus. The walls are of reinforced concrete construction in the form of Hyrib expanded steel covered with cement plaster, and have a thickness of 2 in. This construction makes the building absolutely fireproof and except for the window frames and sashes this feature is carried throughout. The danger of fire from the small amount of wood contained in these parts is remote, as any probability of fire would be from sources within the building and probably never from fire which could be communicated from the outside.

In the main bay are placed the three main generating units, and the two exciter units. In a recess under the switchboard and in the center of the building are all the auxiliaries. The arrangement of apparatus has been carefully considered from the standpoint of operation, this system having, like all large transmission systems, its own problems and peculiarities to contend with. It is intended that a man at the switchboard will at all times have complete control of every part. At the same time he will be within sight of every piece of apparatus and also within sight of the assistant operator who may be at any part of the building. This reduces the efficient running force to two men, and in case of emergency the plant can be operated entirely by the man at the switchboard.

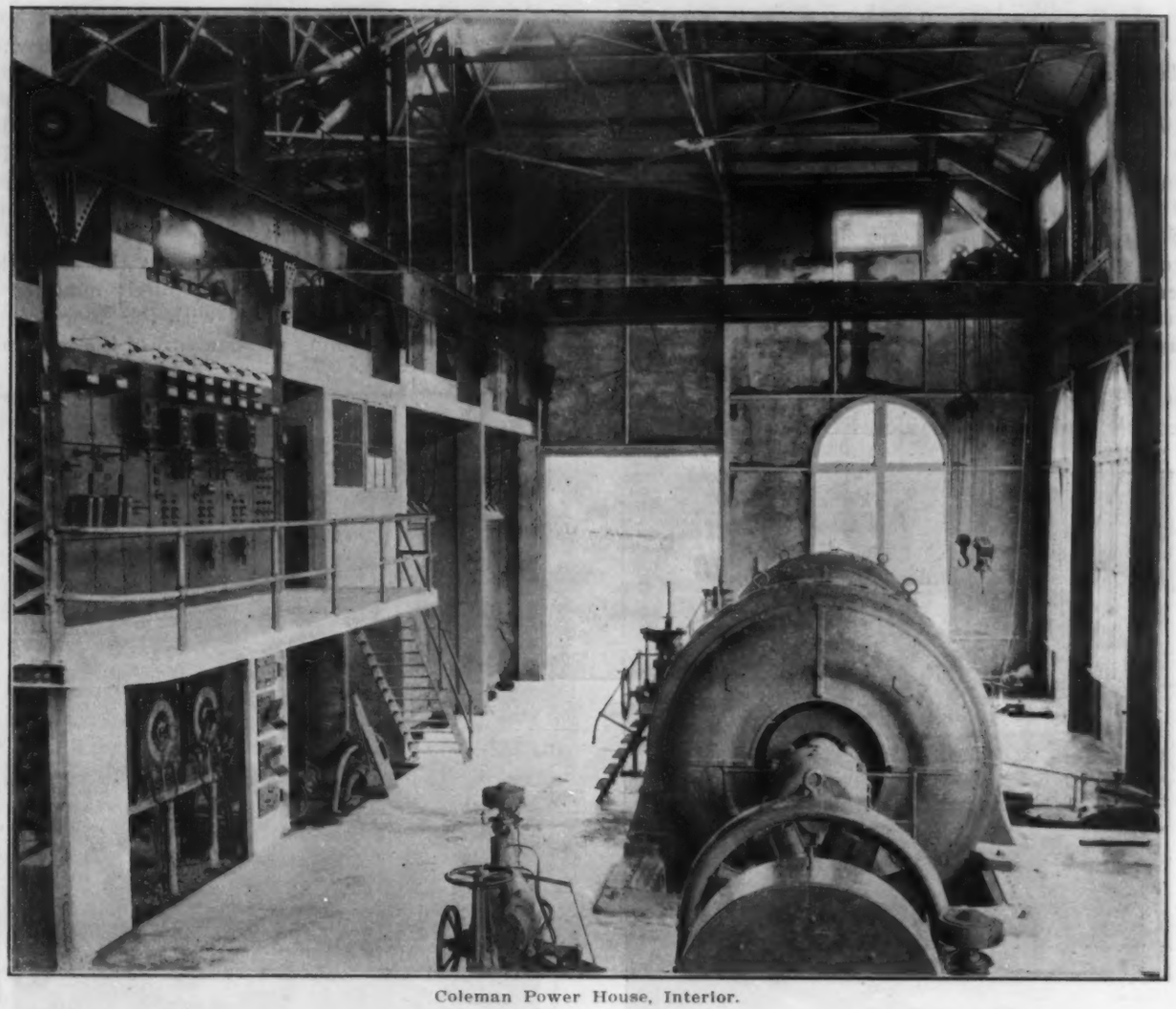
At the rear of the main bay is a line of supporting columns which carry the second and third floors in the building. Between these columns and setting back from the main bay are the cells containing the four raising transformers. On the second floor, which extends between the four center columns of the building, is the switchboard and controlling apparatus, 10 ft. above the main station floor. A platform extends out into the main bay 4 ft. which enables the switchboard operator to see every part of the interior. At the left of the switchboard are two rooms, one of which is used as an office or record room, and the other as a telephone booth. At the right of the switchboard is a dressing room and lavatory for the operators. To the rear of the switchboard is a storeroom.

On a level with this floor and in the rear, extending the entire length of the building, is the high tension operating room. This is reached from the switchboard through two fire-proofed doors. In this room, mounted on the floor are seven sets of 3-pole 66,000 volt oil circuit breakers. Directly over these circuit breakers and supported from the steel frame of the building are the disconnecting switches which operate in connection with the circuit breakers. On the rear wall of the building are mounted the line disconnecting switches, the choke coils and line ammeters, and directly above these, placed in the wall are the wall insulators through which the outgoing lines pass.

The third floor of the building is 10 ft. above the switchboard floor and occupies in width only the space above the transformers, but extending throughout the length of the building. On this floor are placed generator and transformer, 6000 volt circuit breakers and their disconnecting switches, all being mounted in concrete compartments. The connections from the generators to these switches pass under the main station floor and thence up the walls between transformer compartments and directly into the circuit breaker compartments. These conduits consist of three in. Orangeburg fibre laid directly in the concrete. The cables connecting the generators and the switches are 600,000 c.m. varnished cambric covered and weatherproofed.

The interior of the building is given a plain plaster finish without any effort to conceal the structural steel of the frame. The roof is of galvanized corrugated iron directly mounted on steel channels. The gutters are formed into the coping and are of reinforced concrete. There is a monitor 5 ft. higher than the main roof and 12 ft. wide which was adopted to give ventilation during the summer months, when there is always experienced much warm weather. This monitor is amply supplied with windows which can be left open at least part of the year. The underside of the roof and all structural steel are painted a pale blue, giving a light and pleasing finish.

The exterior finish of the building is plain, only enough decorative finish being allowed to give the building a chaste appearance and some attempt at architectural symmetry. The upper circular part of



Coleman Power House, Interior.

the windows are finished with an ornamental projection which prevents rain and water running down the wall from leaking past the window frames. Between the main part of the wall and the second row of windows there is a lintel or cornice which, while it is proportioned for a decorative effect, acts as a water shed in addition to the projections over the windows. The eaves are built into the coping and water from the roof is carried away through short pipes which are inserted through the coping.

Between the power house and Battle Creek there is a natural swale which extends parallel to and down the creek for a distance of about a quarter of a mile, This was probably caused by the throwing up of a gravel bar which now confines the creek. The existence of this swale made it possible to form a discharge canal which allows the discharge flow to join the creek at a point where a considerable drop is obtained. Beginning directly in front of the power house an excavation has been made down to the bottom of the level of the draft tubes. This excavation is about 40 ft. wide; it is lined with concrete retaining walls and floor.

By this means a pond or afterbay is formed in front of the building which maintains draft at all times. Beyond the afterbay the discharge is contracted to form a narrow straight section. This is for use of an Anderson measuring device. Beyond this the ditch is extended to carry the flow to a point where it can join Battle Creek.

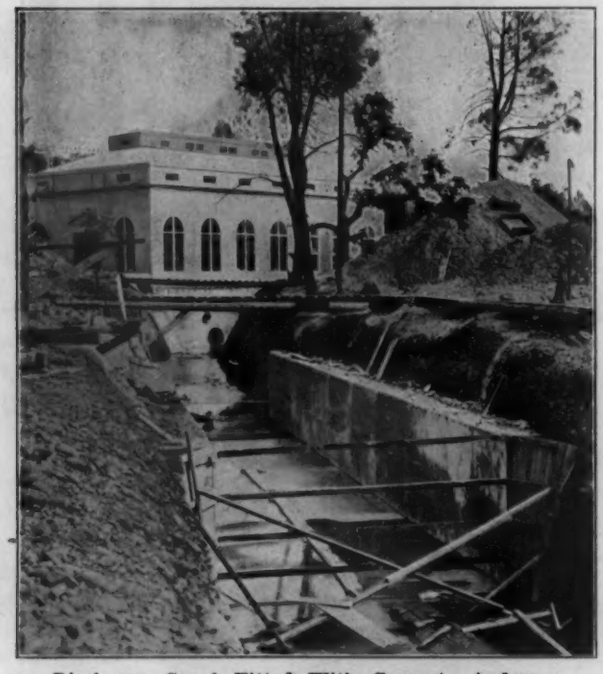
Concrete Afterbay, Showing Draft-tube Openings of Main Wheels and Automatic Relief Valve Outlets.

Underneath the rear portion of the power house and on a level with the main station floor is a space 12 ft. wide and the length of the building which is utilized as a shop and storeroom. This is a handy arrangement as it brings the shop close to the center of operation. At the same time it is out of view from the main interior and is separated by fireproof walls.

Equipment.

There are three main generator units. These are placed in the main bay, the center line being parallel to the length of the building. Each consists of a 4000 k.v.a., 3-phase, 6600 volt generator, which operates at 450 r.p.m. These generators are interesting on account of their liberal design and also for the high speed at which they operate. The rotors have a diameter of 7 ft. The field poles are dove-tailed into a cast steel spider. The coils are built in the ordinary manner of strip copper one turn per layer wound on edge. Between the poles are placed the customary brass damping plates.

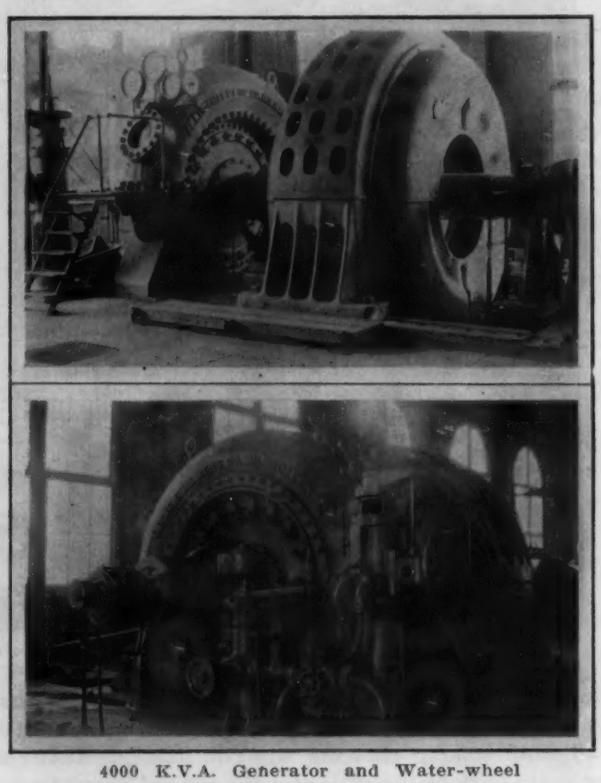
The stator or armature is built in the ordinary manner, the 3-phase windings being arranged 2 slots per pole, and are star connected. The system of ventilation and cooling is ingenious. The ventilating ducts in the laminations are placed close together at the center of the stator and the spaces are gradually increased toward the edges. This allows a greater quantity of air at the point of greatest heat. The outside cast iron frame is amply provided with ventilating openings. On both sides of the frame are bolted large cast iron end-bells. On both sides of the rotor are mounted centrifugal fan blades, held together by a shield, the whole being constructed of sheet steel and riveted. The rotary action of this part sucks air through the ventilating opening of the outside frame, thence through the openings in the laminations, past the coils, thence out on either side through the fan blades and the draft is eventually delivered parallel to the shaft in both directions.



Discharge Canal Fitted With Concrete Anderson Measuring Flume.

The water wheels each consist of a single runner of Francis type. They are inclosed in the ordinary cast iron scroll casing. The wheel is mounted close to the generator so that there are but two main bearings. The shaft is, however, continued through the runner into a third collar or thrust bearing. This consists of a number of rings integral with the shaft which run in an oil bath and take up the discharge thrust on the runner. The runner has a diameter of 34 in. and discharges in one direction into the draft tube. The wheel has a full load rating of 7000 horsepower. The makers guarantee the following efficiencies: at one-half load 78 per cent; at three-quarters load 80 per cent; at full load 82 per cent.

The penstock delivering water to the scroll lies below the power house floor. Separately mounted on two cast iron bases, at a level with the floor are the operating and controlling mechanisms of the governor.



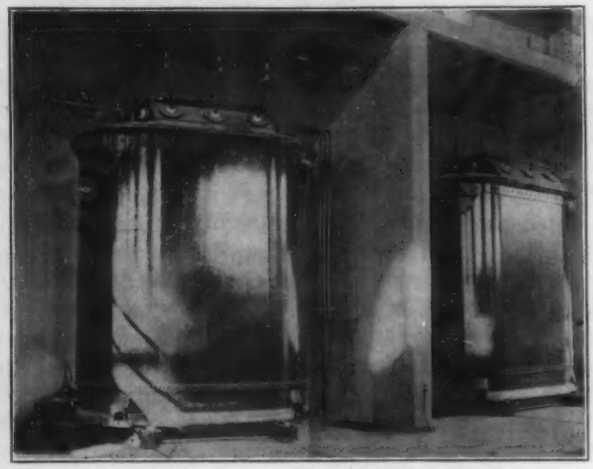
4000 K.V.A. Generator and Water-wheel 7000 H.P. Francis Turbine and Governor.

This is designed and built by the manufacturers of the water wheel but is of the Escher-Wyss type and is operated by oil under a pressure of 250 lb. per sq. in. The exciters are two in number and are placed together between the second and third generating unit at a point handy to the switchboard should it be necessary for the switchboard operator to reach them quickly. The exciter generators have a capacity of 225 kw. They are direct current, 120 volts and operated at a speed of 550 r.p.m.

The generator is of the standard two-bearing type and the water wheel runner is mounted on the end of the generator shaft and is overhung. The water wheel is of the tangential impulse type and is inclosed in a cast iron housing. The nozzle is of the needle type and is operated by a governor somewhat similar, but smaller, to those of the main machines. Within the recess, directly beneath the switchboard gallery, the office and the dressing room, are placed the auxiliaries as before stated. This space is 48 ft. long by 12 ft. wide and is on the main floor level. Within the space

are placed two motor driven oil pumps to operate the governors. These each consist of a direct current 50 h.p., 120 volt motor, driving through a Morse silent chain, a gear type oil pump which is inclosed in a cast iron reservoir. There is also placed is this space a two cylinder, 6 in. x 6 in. water cooled air compressor, belt driven by a 15 h.p., 220 volt induction motor, and also a General Electric, type FP. 7 in., transformer-oil filter.

Mounted directly under the switchboard and on an iron frame are the three main generator field rheostats. The pumping units were furnished by the Allis-Chalmers Co. of Milwaukee; the oil filter being furnished by the General Electric Co., and the rheostats by the Cutler-Hammer Co. The electrical connections between the main generators and the switches on the third floor gallery are through Orangeburg fibre duct laid directly into the concrete floor and



Two 4000 K.V.A. 3-Phase Transformers.

walls. Within each duct is placed the 600,000 c.m. muslin insulated cables. The main leads from the exciters are placed in Orangeburg fibre duct and consist of bare copper bars. This device was used to provide the large carrying capacity necessary and the Orangeburg forms sufficient insulation for the low voltage employed.

The transformers are four in number, one being a spare. Each transformer is placed in a recess 16 ft. long and 12 ft. deep. They are mounted on low structural steel cars. These cars are made up of I beams and cast iron wheels inclosed, and were designed to develop the necessary strength and at the same time raise the transformers a minimum distance of 8 in. above the floor. They run on 30 lb. T rails inserted in the concrete floor which extend out into the main bay, so that the transformers may be moved out where they can be picked up by the traveling crane.

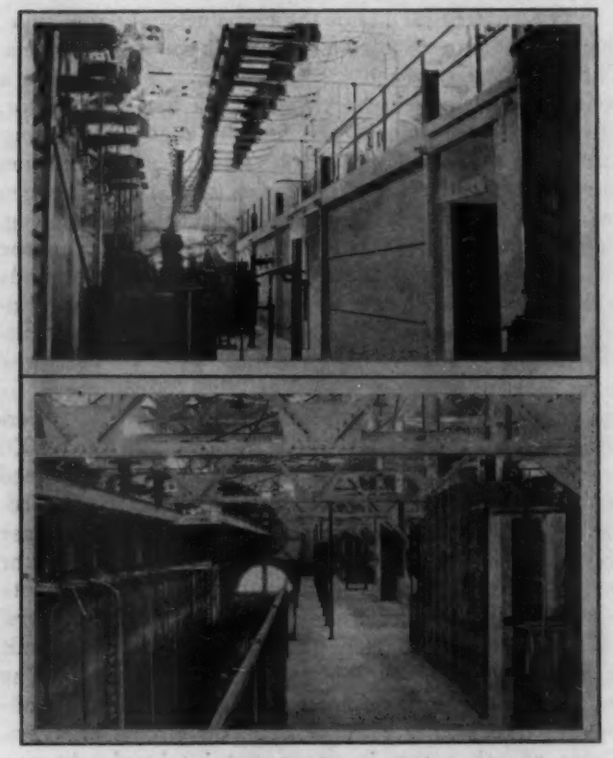
The transformers have a capacity of 4000 k.v.a. They are 3-phase delta connected on the primary side for 6600 volts and star connected on the secondary side for 66,000 volts. They rest in sheet steel cases with cast iron bases, tops and covers. The cooling is accomplished by three sets of copper coils and the transformer is immersed in oil in the usual manner. Both low and high tension leads are taken out through the cover through the conventional bushings, the high tension bushing being filled with insulating compound. The total weight of the core and case is 20 tons and of the oil, 10 tons, making the weight on the base 30 tons. Each transformer is equipped with a 4 in. quick opening valve near the bottom. This connects with the extensive oil-storage and filter system, and also with a special sewer for use in case it is desired to entirely get rid of the oil. There is also a ¾ in. filling pipe. This is carried up the side of the case to the top and after entering extends to the bottom of the case. Through this pipe oil may be delivered from the storage tanks and incidentally through the filter, directly to the bottom of the transformer. Thus the transformer may be filled without splashing or getting air trapped under the oil.

The switchboard is of the conventional panel type, the slabs being of black slate. There are 7 panels. The first two are each for an exciter. The third is a control panel on which is mounted a Tirill regulator. The next three panels are for the main generating units, and the last panel controls the transmission lines. The switchboard occupies the space between two steel columns at the exact center of the building. Before it is the 4 ft. balcony extending out into the main bay on which the switchboard operator stands and from which he can observe all parts of the building. Mounted upon the first two panels are the voltmeters and ammeters, and a double pole, single throw main line exciter switch. On the third panel is mounted the Tirill regulator which derives its operating current from potential transformers in the 66,000 volt bus lines. The generator panels are each equipped with one ammeter and three point switch, one recording polyphase wattmeter, one integrating polyphase wattmeter, one frequency indicator, one power factor meter and the control handles to operate the remote control generator and transformer oil circuit breakers.

On the lower part of these panels is a time limit relay to operate on the aforesaid circuit breakers. The transmission line panel is equipped with the controlling apparatus to trip the 66,000 volt circuit breakers. These switches are, however, set by hand. At one end of the switchboard, and in the rear of it is placed the extra panel on which are mounted double throw switches controlling the 14 station lighting and outlying building circuits, the reservoir indicators and bell and signal circuits. To the left of the switchboard in the telephone room are four circuits coming from the outside. Mounted on a steel frame is a telephone switchboard equipped with 12 d.p.d.t. and 7 d.p.s.t. knife switches and the proper connections to the various circuits. There is also an extension connection from the telephone room running through conduit to a point in the floor directly in front of the switchboard. This is so that the switchboard operator may have a telephone with him at all times which he can plug into the floor receptacle, and enables him to have telephone conversation without leaving his switchboard. The telephone lines on entering the rear wall of the building pass to fuses and G. E. type Y 108 Form B telephone transformers. These have a ratio 1 to 1 and are tested to 25,000 volts.

On the third gallery or floor directly above the transformers, as before stated, are mounted the generator circuit breakers. These switches are General Electric Type K4. They are 3-pole, single throw, oil immersed and are solenoid operated and tripped. They are mounted in concrete cells. The disconnecting switches are placed between the generator and transformer circuit breakers, and also an equalizing bus.

In operation, current passes through the generator K4 circuit breaker, thence through two sets of disconnecting switches, which are mounted in their respective concrete cells and thence through the transformer K4 circuit breaker to the transformer. The equalizing bus connection is taken off between the two sets of disconnecting switches already mentioned and has in its own line a set of disconnecting switches. There are 4 of these sets of circuit breakers and disconnecting switches in their respective concrete compartments. The equalizing bus extends the length of the building directly in the rear of the four sets and consists of 600,000 c.m. muslin covered cable placed in Orangeburg fibre which in turn is embedded in a concrete wall. The switch sets are placed directly over their respective transformers and in all cases offer the shortest distance between generator and switch, and switch and transformer. While they are near to the switchboard so that in case of trouble they can be easily and freely reached they are entirely out of the way of unauthorized persons who might be wandering around the station and accidentally come in contact with a live part.



High Tension Switch Gallery, Showing Oil Circuit Breakers on Outgoing Lines in Foreground and Disconnecting Switches Overhead.

Low Tension Switch Gallery, Showing Generator and Transformer Switch Cells on Right and High Tension Switches on Left.

Station Circuits.

The high tension 60,000 volt circuit breakers are mounted on the second or switchboard floor but occupy a space in the rear of the switchboard and transformer compartments and extending the entire length of the building. There are four sets of three single pole circuit breakers for the transformers and three sets of three single pole circuit breakers for the three outgoing transmission lines. There are two sets of high tension bus lines which are suspended from the main roof trusses of the building, being fastened to two section Locke suspension insulators. The circuits are arranged so that current passes from the transformer directly into its oil circuit breaker, thence through two sets of disconnecting switches to the two bus lines. Outgoing current passes from the two bus lines through two sets of disconnecting switches, thence joining and through the outgoing oil circuit breakers, thence through another set of disconnecting switches, a high tension ammeter, and choke coils, into the line.

Great care has been taken in arranging this section to prevent the possibility of confusion in a time of trouble or of accident of any kind, which may arise, and the arrangement has been made just as nearly foolproof as it is possible to do so with such an elaboration of connections. The transformer circuit breakers are placed against the wall adjacent to their respective transformers. The line circuit breakers are placed on the other side of the room against the wall directly below their respective lines. The disconnecting switches are placed in two lines throughout the length of the room, being hung from steel channels, supported from the stiffening trusses of the building and are placed horizontally. The disconnecting switches for the outgoing lines are placed on one line. Those on the transformer circuit breakers are placed on another line and in all cases these switches are directly above their respective oil switches. The horizontal arrangement of these switches was made for the purpose of simplicity and safety of operation as there is nothing beneath them to interfere in any way in operating them. To prevent the possible danger of their falling out in case the switch jaws should become loosened, a device designed for this installation has been placed on the clip which automatically locks the bar with a latch when the switch is closed. The act of pulling the switch open, automatically opens the latch, the two actions being made at the same instant. This device, while simple is positive and prevents the possibility of serious trouble.

The high tension circuit breakers are General Electric Type KIO. The disconnecting switches are of the same make and of the standard type, mounted on porcelain columns. All wiring is done with ¾ in. copper tubing to prevent corona, and reduce the danger of short circuiting between lines. Throughout, a consistent distance between wires has been maintained of 3 ft. and between any wire and any ground of 2 ft. In case of a short circuit in the high tension wire the greatest damage that could probably be done would be the shutting down of the plant, as there is absolutely nothing to burn. There are no barriers or cells of any description in the high tension work.

Contrary to past practice in California the wires leaving the building do not pass through windows or openings but through the center of a Locke wall insulator. This insulator was designed for this plant and consists of an 18 in. wall insulator in which is cemented a 3 in. glazed porcelain tube 3 ft. long. The conductor through the insulator is a piece of brass tubing threaded at each end and supplied with lock nuts and connectors.

In order that these insulators could be mounted in the steel and concrete wall cheaply and also in such a manner that the insulators could be easily removed without breaking or damaging the wall, a simple device was adopted. A circular opening was left in the steel reinforcement, slightly smaller than the insulator. Fastened to this on the outside was a ring made of thin galvanized iron, having a diameter slightly in excess of that of the insulator, and a width of 1½ in. This served as a socket in which the insulator could be placed. The concrete was then applied to the reinforcement, and a tight joint made around the sheet iron ring. After the insulator is placed in the wall a ring made of common ½ in. round iron of a size to just slip within the sheet iron ring is placed against the insulator, and this ring is in turn held in place by four wrought iron clamps which are held by ½ in. bolts permanently placed in the wall outside of the sheet iron ring. Should an insulator be broken, it may be removed from the outside by simply loosening the four nuts holding the clamps, which hold the movable ring, and a new insulator may be immediately inserted, and fastened. The circuit after passing through these insulators is carried directly to the pole structures of the various lines which are equipped with General Electric aluminum cell lighting arresters. These are placed in a small steel and concrete building about 100 ft. to the rear of the power station, and consist of horn gaps mounted on structural frame, and aluminum cells immersed in oil.

Station Wiring.

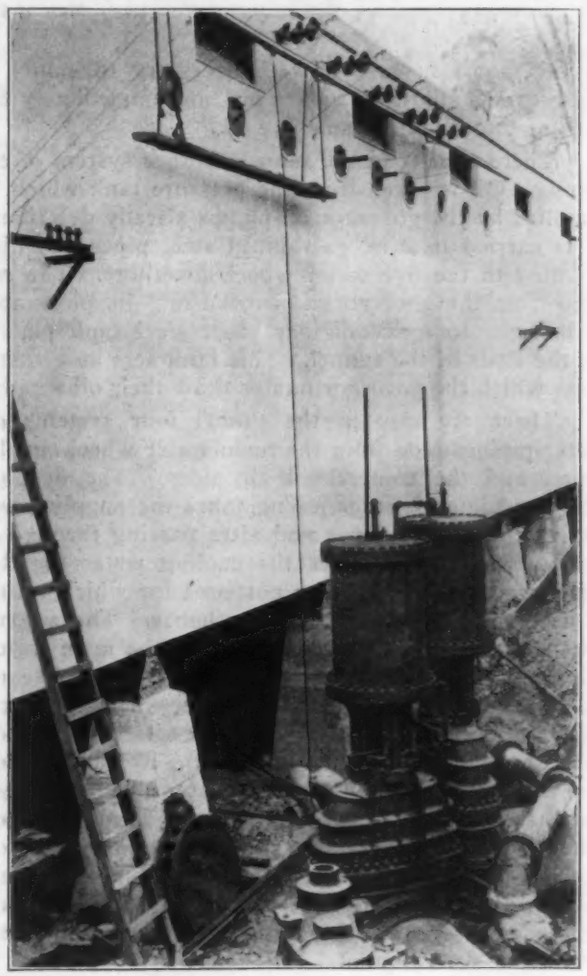
All operating connections between the high and low tension circuit breakers and the switchboard; also telephone wires, reservoir signal wires and lighting wires are carried in the concrete floors in galvanized steel duct. Provision is made for lights at every point of the building where it might be necessary to use a light either continuously or on occasion. The main bay is illuminated from six, four-light tungsten clusters, mounted on the lower chord of the roof trusses. The high tension compartments are similarly lighted with two lamp clusters.

Poles.

All high tension lines and connections outside of the building are mounted on reinforced concrete poles. These poles vary in length from 30 to 50 ft., as to their requirement. They are square in section with a minimum width at the top of 8 in. and a width at the bottom of 14 in. in the highest poles. They are reinforced with round steel rods and were made at the point of erection.

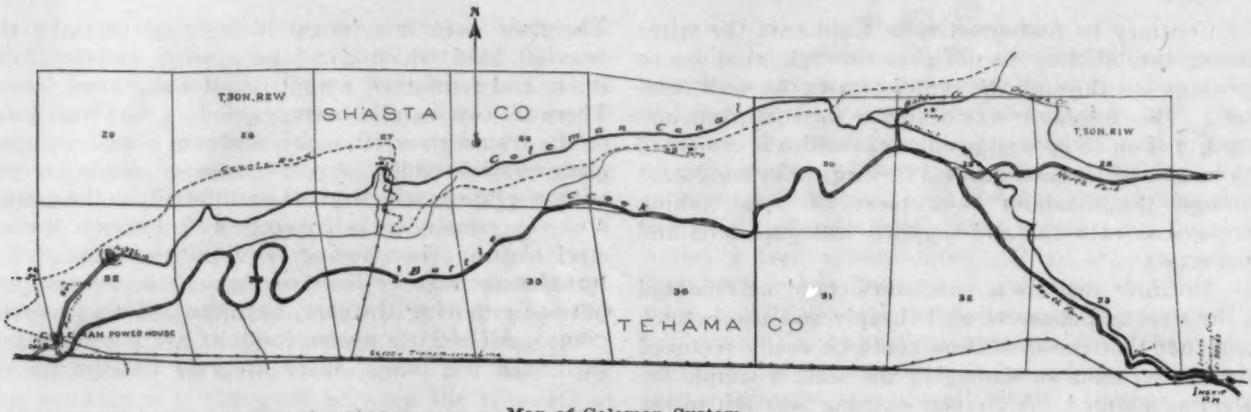
Tunnel.

As already stated there is a tunnel under the main floor of the building, which extends through its length. The floor over this tunnel is designed to carry the heaviest load which could be applied, and is 12 in. thick, and reinforced with triangle mesh steel fabric. There are two man holes corresponding with man holes in the transformer oil tanks, and one large opening made of steel shapes. A part of this opening is covered with a grating which gives ventilation to the tunnel and the remainder is covered with heavily trussed steel plates. The opening is of sufficient size that a transformer may be lowered through it, for the purpose of removing the core, by means of the traveling crane. All electric power conduits are placed in this floor. In the tunnel there are two transformer oil



Rear of Power House, Showing Wall Insulators of Outgoing High Tension Lines and Main 48 in. Hydraulic Gate Valves.

storage tanks. These are each 6 ft. in diameter, 16 ft. long, and will hold a quantity of oil somewhat in excess of that used in one of the raising transformers. The piping system between these tanks and the transformers is extensive and will allow oil to be circulated from any transformer to either tank; from one tank to the other; from either tank through the filter to any transformer or to a point outside of the building, or from one tank through the filter to the other tank. The movement of oil may be accomplished either by applying compressed air to the tanks or by means of a motor driven oil pump on the oil filter. This system allows, not only of filtering the oil, but of



Map of Coleman System.

preserving it in case it were necessary to empty a transformer following a burn out, and immediately fill a transformer with clean spare oil.

There is also, in the tunnel another system of oil piping. Oil is taken from the pressure tank which is supplied by the governor oil pumps already described. It is carried in 2 in. galvanized steel pipes and distributed to the five water wheel governors. The return from the governors is carried in 3 in. pipes and is brought to a rectangular sheet steel tank placed on the floor of the tunnel. This tank acts as a sump from which the governor pumps draw their oil supply.

There are also in the tunnel four systems of water piping aside from the main water wheel supply pipes, and the compressed air pipes. The first of these systems of water piping takes the supply from the exciter supply pipes and after passing through a pressure reducer supplies the cooling water for the transformers, and all other purposes for which water is used in and about the power house. The second system takes its supply from each of the main water wheel feeder pipes and is used for the purpose of filling the draft tubes before the water wheel is started in operation. The third system takes its supply from each of the main pipe lines back of the hydraulic gates and through a manifold, supplies water under full pressure head to operate the relief valves on the main water wheels. The fourth system supplies cooling water for the generator bearings, and is taken from the house system. All this piping is arranged to be free of access at all times. The tunnel is ventilated and drained at several points.

The construction work on the Coleman system has been carried out entirely by the company's own corps of engineers, with the exception of a small part of the canal which was built under force account contract. The work of this section has been under the general charge of Mr. Edward Whaley. The construction of the power house has been in charge of Mr. Perry O. Crawford, and the work designed by the writer who has acted as consulting engineer for the company. The time of construction from the letting of contracts for machinery to the completion and commencement of operation, has occupied one year and five months, which, considering the magnitude of the work should be recognized as a creditable record.

LOS ANGELES NEWS LETTER.

The opening meeting of the Los Angeles Section of the American Institute of Electrical Engineers was addressed by Dr. J. A. B. Scherer, president of Throop Polytechnic Institute, and Mr. George A. Damon, dean of the same institution, at Hamburger's Cafe, on October 17th. The meeting was presided over by Mr. O. H. Ensign, with about 130 in attendance. Mr. Ensign named the chairman of the different committees for the coming year as follows: Papers Committee, Prof. R. W. Sorensen of Throop Polytechnic Institute; Discussions Committee, Mr. C. E. Hogle, of the U. S. Reclamation Service; Membership Committee, Mr. J. E. Barker of the Los Angeles Aqueduct; Entertainment Committee, Mr. A. Kean of the Pacific Electric Railway. The executive committee consists of O. H. Ensign, chairman; E. R. Northmare, secretary; C. G. Pyle, assistant secretary; J. A. Liththipe, E. F. Scattergood, J. E. McDonald, and R. H. Manahan. Regular meetings will be continued throughout the winter on the third Tuesday of each month, to which all visiting engineers are cordially invited.

The contract has been let for the street lighting at Pasadena, on Orange Grove avenue. There will be over 200 solid bronze ornamental posts, costing approximately $100 each. This work is being installed by the Southern California Electric Company, of Los Angeles, at a contract price of approximately $35,000. Both of the telephone companies, the Edison Company and the municipal plant, are preparing to remove all overhead wires and service connections on this street.

The municipal plant at Glendale, California, will within the next thirty days extend their lines for street lighting and service connections into West Glendale and Tropico. Plans and specifications are being drawn for about a mile of ornamental street lighting work and an underground system on the main streets in Glendale.

The city engineer of Redlands, California is again drawing specification covering a system of ornamental street lighting throughout the business section.

The Home Telephone & Telegraph Company of Los Angeles are contemplating building two or three new sub-stations in the city during the coming year, together with other improvements, at an approximate cost of $350,000.

PRIMER OF APPLIED THERMODYNAMICS.[1]
TENTH LECTURE.
Elements of Forced Draft.

Years ago Gallileo, an eminent scientist of Italy, and the first inventor of the telescope, climbed the historic "leaning tower of Pisa" and by dropping cannon balls of different sizes and weights from the top of the tower found that all fell to the ground in an equal time interval. This can mean but one thing; namely, that no matter what the size or weight of a body may be, the velocity acquired in falling at a given place through a given distance is identical in each case, and is independent of the weight of the body. Hence it is seen that the height through which the body is to fall is the essential factor entering into the computation of velocity. It is found in elementary mechanics that this velocity is computed from the simple relation

$$v = \sqrt{2gh}$$

in which v is the velocity in ft. per sec., g is the so-called gravitation constant usually taken at 32.16, and h is the head or height through which the body falls.

Now let us take a column of water h ft. in height as shown in Fig. 23. It is evident that on the bottom

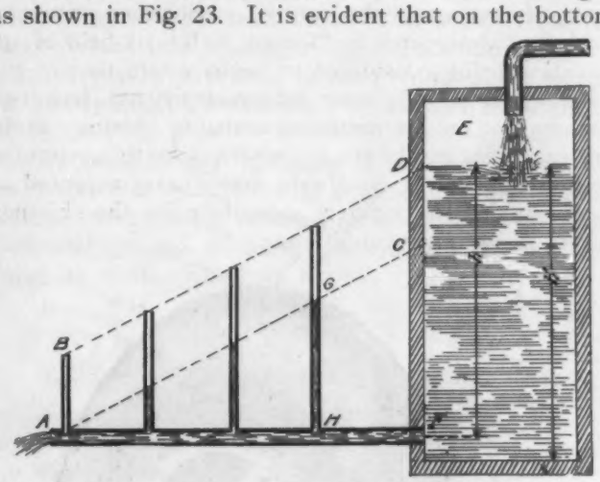


Fig. 23. Water Analogy of Friction Loss in Pipes.

of the tank there would be a pressure over every square foot of surface in amount equal to the weight of $h \times 1$ cubic foot of water. If then d is the weight of 1 cubic foot of water the pressure per square foot is equal to

$$p_1 = h \cdot d$$

If now we fill the entire enclosure with a gas—say air for example— and can measure the pressure, we can apply our formula if we know the density or weight of the gas per cubic foot. In other words, we can at once compute h which is from the above.

$$h = \frac{p_1}{d}$$

Hence we make at once a formula for the flow of gases under pressure

$$v = \sqrt{2gh} = \sqrt{2g\frac{p_1}{d}}$$

[1] A resume', devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.

This is a most important relationship for it can at once be applied to steam turbine velocity computation and also to computation relating to the air compressor. For instance, dry air at 50° F. has a density of 0.0779 lb. Consequently if we take air at ordinary pressure of (14.7×144) lb. per square foot and let it flow into a vacuum, we get an enormous velocity.

$$v = \sqrt{2g\frac{p_1}{d}} = \sqrt{\frac{2 \times 32.16 \times 14.7 \times 144}{0.0779}} = 1321.7 \text{ ft per sec.}$$

We have perviously found, however, that there is a most important relationship connecting the pressure, volume and temperature of gases which is symbolically expressed as

$$pv = RT$$

where p is the pressure in lb. per square foot v is cubic feet in 1 lb. of gas, R is constant, and T the absolute temperature. Since density is the weight per cubic foot of a gas, we have the important relationship

$$d = \frac{1}{v} \text{ or } d = \frac{p}{RT}$$

Hence we can determine at once the density of the gas under consideration for any pressure and temperature, and having computed this, we then find its velocity of efflux by substituting in the formula

$$v = \sqrt{2g\frac{p_1}{d}} = \sqrt{\frac{2gp_1\ RT}{p}}$$

We must, however, be careful in substituting the correct value of p_1 in the last formula by remembering that this p_1 is the difference in pressure between the compressed gas and the outer air or chamber into which the gas discharges, while p is the absolute pressure of the gas under compression. A single example will suffice to illustrate this. Let us find from the above formula the velocity of dry air of 50° F., escaping into the atmosphere through any shaped orifice in any pipe or reservoir, in which the pressure is 4 oz. above the outside atmospheric pressure. Here we have $g = 32.16$, $p_1 = \frac{4}{16}$ lb. per square foot, $R = 53.37$, $T = 459.4 + 50$, $p = 14.7 + \frac{4}{16}$. Hence substituting we have

$$v = \sqrt{\frac{2gp_1\ RT}{p}} = \sqrt{\frac{2 \times 32.16 \times 0.25 \times 53.37 \times 509.4}{14.95}}$$

$= 171$ ft. per sec.

The quantity in cubic feet per sec, of air or gas under a given pressure that will flow through an orifice is readily computed by multiplying this velocity by the effective area of the orifice in square feet. Thus

$$Q = av = a\sqrt{2g\frac{p_1}{d}} = a\sqrt{\frac{2gp_1\ RT}{p}}$$

The effective area is obtained by multiplying the true area by a so-called coefficient of efflux. The form of the orifice through which the air passes under pressure has practically no effect upon the velocity, but the volume of air discharged is largely dependent

upon the character of the opening. The coefficient of efflux and consequently the volume discharged may be greatly increased by proper design of the opening which should be of such form as will render easier the outflow of a fluid.

In round numbers the coefficient of efflux when the pressure differences are comparatively small, as in the case of a fan for mechanical draft, may be taken as follows:

For air orifice in a thin plate	0.56
For a rounded-off conical mouthpiece	0.98
For a short cylindrical pipe	0.75
For a conical pipe whose angle of convergence is about 6°	0.92

In the study of hydraulics, it has been determined that there is a certain loss of effective head due to the friction of water against the sides of the conducting medium. This loss in head is found to be very approximately proportional to the square of the velocity, to the length of the pipe, and inversely proportional to the diameter. Thus:

$$h^1 = f\frac{l}{d} \times \frac{v^2}{2g}$$

in which f = coefficient of resistance of friction, determined by experiment.
l = length of pipe in feet.
d = diameter of pipe in feet.
v = velocity in feet per second.
g = acceleration due to gravity = 32.16.

For air in galvanized iron, carefully made and erected with all internal laps extending in the direction of air movement, by experiment f has been found to have a value of 0.039, while for water flowing in pipes, it has an average value of 0.02. The value of f, however, is not an exact constant. In the investigations of Unwin, it was found that $f = C\left(1 + \frac{36}{10d}\right)$. It is evident that this difference for f is very slight for pipes of large diameters.

We are now ready to see at a glance how the formula for chimney design with varying altitude above sea-level assumed in the last lecture can readily be determined.

Thus since $h^1 = f\frac{l}{d} \times \frac{v^2}{2g}$ and $h^1 = \frac{p}{D}$

we have $p = f\frac{l}{d} \times \frac{v^2}{2g} \times D = C\left(1 + \frac{36}{10d}\right)\frac{l}{d} \cdot \frac{v^2}{2g} \cdot D$

or $p = B\left(1 + \frac{3.6}{d}\right)\frac{l}{d} \cdot v^2 D$, where $B = \frac{C}{2g}$

$$\text{weight} = W = q \times D = a \cdot Dv = \frac{\pi d^2}{4} \cdot v \cdot D.$$

$$\text{or } v = \frac{W \times 4}{\pi d^2 D}$$

$$\therefore v^2 = \frac{W^2 \times 16}{\pi^2 d^4 D^2} = C_1 \frac{W^2}{d^4 D^2}, \text{ where } C_1 = \frac{16}{\pi^2}$$

Hence substituting, $p = C\left(1 + \frac{3.6}{d}\right)\frac{l}{d} \times \frac{C_1 W^2 D}{d^4 D^2}$

$$= C \cdot C_1 \left(1 + \frac{3.6}{d}\right)\frac{l W^2}{d^5 D}$$

or solving for W we have

$$W^2 = \frac{pDd^5}{CC_1\left(1 + \frac{3.6}{d}\right)l}$$

$$\text{or } W = K\left[\frac{pDd^5}{\left(1 + \frac{3.6}{d}\right)l}\right]^{\frac{1}{2}} \text{ where } K = \sqrt{\frac{1}{CC_1}}$$

The constant K has a value of 87 for steam and 64 for air. In this formula W is the flow in lb. per min., p is the difference in pressure between ends of the pipe under consideration in lb. per sq. in., D is the density or weight in lb. per cubic feet, d is the diameter of pipe in inches, l is the length of pipe in feet.

When steam flows out into the atmosphere an approximate formula known as Napier's formula is very convenient in computation. $W = \frac{6}{7} p\, a$, in which p is the absolute pressure in lb. per square inch, and a is the area of orifice in square inches.

Let us now turn our attention to the question of mechanical draft. Primarily introduced for the purpose of increasing the rate of combustion, artificial draft was designated as "forced draft," its field of application being considered to begin where that of the chimney ended. By later refinements it has, however, become not only a means of assisting chimney draft, and of producing the conditions requisite to accelerated combustion, but it is now in many cases accepted as a convenient and efficient substitute for the chimney under all ordinary conditions.

Fig. 24. Mechanical Draft Blower.

In Fig. 24 will be seen a typical example of a blower used in the production of mechanical draft. In this illustration is seen a steel pressure blower manufactured by the Sturtevant Company of Boston, Massachusetts. This type of fan, as its name indicates,

is a pressure blower rather than a volume blower. That is, the wheel is of such dimensions as to make it possible to deliver a comparatively small amount of air under high pressure. Other designs are of course made by this company and other manufacturers to meet the opposite condition, or large volume of air delivered under low pressure.

It is interesting to look into some of the fundamental equations of forced draft in order to get an idea of economy in installation. From fundamental mechanics we learn that energy is found in nature in two forms, kinetic and potential. Energy of life or motion described by the Romans as "vis viva" is expressed mathematically as the mass of a moving body multiplied by ½ the square of its velocity in symbols is $\frac{W v^2}{2g}$. Again a body may not have motion at all and yet possess energy. Thus a stone on a high hill possesses energy from its very position for if unbalanced in its high position it may at any moment descend great distances and do work. The hammer of a pile-driver lifted to its upper limit possesses this potential energy and the next instant this potential energy is converted into kinetic energy. Potential energy is mathematically expressed as the product of the weight of a body and its height above the lower plane of descent, or W h.

In considering the theory of mechanical draft let us derive some fundamental equations by putting the kinetic energy of the entering air or gas as equal to the potential energy it must possess in order to perform its work. Thus we have

$$\frac{W v^2}{2g} = W h, \text{ but } p = h \cdot d, \text{ or } h = \frac{p}{d}$$

Hence cancelling out and substituting, we have

$$\therefore p = \frac{v^2 d}{2g}$$

Where p = pressure in lb. per sq. ft.
d = density or weight per cubic foot.
g = gravity constant or 32.16.

Since power is the time rate of doing work, if we have a fan moving at a peripheral speed of v ft. per sec. against a total pressure of a p lb., then the fan performs a p v ft. lb. per second. Denoting Power by P and substituting for p from the above equation

$$P = a v \times \frac{v^2 d}{2g} = \frac{d a v^3}{2g}$$

From these equations we see the important laws in mechanical draft design; namely, the pressure given out by the fan varies as the square, while the power required varies as the cube of the velocity. This is very important to remember in picking a fan to perform given conditions in chimney draft, for by simply doubling the velocity, eight times the power will be required.

It will be instructive to illustrate this by solving a particular installation. Let us suppose that in a power house we need for proper combustion of the fuel, 15,000 cu. ft. of air per min. at a draft pressure of 1.25 oz. Upon investigation we find two mechanical draft apparatus offered. One has a diameter of 30 in., gives a pressure of 1 oz. at 740 revs. per min. and forces 405 cu. ft. per min., requiring 0.16 h.p. per inch of width of blade installed. The second fan has a diameter of 54 in., gives a pressure of 1 oz. at 410 revs. per min. and forces 726 cu. ft. per min., requiring 0.29 h.p. per inch of width of blade installed. Let us compute the widths required and the power in each case.

Let

p_1, v_1 = pressure and velocity necessary to produce required chimney draft, first case.
p_2, v_2 = pressure and velocity necessary to produce required chimney draft, second case.
p_3, v_3 = pressure and velocity of first machine at given rating.
p_4, v_4 = pressure and velocity of second machine at given rating.

Since diam. = 30 in. and r.p.m. = 740

$$\therefore v_3 = 3.1416 \times d \times 740 = \frac{3.1416 \times 30 \times 740}{12} = 5815 \text{ ft. per min.}$$

$$v_4 = \frac{3.1416 \times 54 \times 410}{12} = 5790 \text{ ft. per min.}$$

$$p = \frac{v^2 d}{2g} \text{ or } \frac{p_1}{p_3} = \frac{\frac{v_1^2 d}{2g}}{\frac{v_3^2 d}{2g}} = \frac{v_1^2}{v_3^2}$$

$$\frac{p_1}{p_3} = \frac{v_1^2}{v_3^2}$$

substituting

$$\frac{1.25}{1.00} = \frac{v_1^2}{(5815)^2} \text{ or } v_1 = 5815 \sqrt{\frac{1.25}{1.00}} = 6500 \text{ ft. per min.}$$

$$\frac{1.25}{1.00} = \frac{v_2^2}{(5790)^2} \text{ or } v_2 = 5790 \sqrt{\frac{1.25}{1.00}} = 6470 \text{ ft. per min.}$$

Similarly, where q is total quantity of air per min.

$q = av$

or

$$\frac{q_1}{q_3} = \frac{av_1}{av_3} = \frac{v_1}{v_3}$$

$$\therefore q_1 = q_3 \frac{v_1}{v_3} = 405 \times \frac{6500}{5815} = 453 \text{ per in. of width.}$$

$$q_2 = q_4 \frac{v_2}{v_4} = 726 \times \frac{6470}{5790} = 811 \text{ per in. of width.}$$

Hence width of first fan is $\frac{15000}{453} = 33.4$ in.

width of second fan is $\frac{15000}{811} = 18.5$ in.

Power required first fan $P_1 = 33.4 \times \left(\frac{6500}{5815}\right)^3 \times 0.16 = 7.49$ h.p.

Power required second fan $P_2 = 18.5 \times \left(\frac{6470}{5790}\right)^3 \times 0.29 = 7.48$ h.p.

Hence it is seen in this case that the powers required are practically the same, although the sizes of apparatus vary considerably.

Many times short chimneys are used and mechanical draft apparatus installed, consisting of either an exhaust fan in the smoke flue or a mechanical or steam-jet blower underneath the grate bars. An INDUCED

DRAFT is produced by the former and a FORCED DRAFT by the latter. The advisability of installing mechanical draft apparatus is dependent upon the results of an economical comparison with the saving resulting from the lessened necessary height of the chimney and the useful results or saving accomplished by installation of an economizer in the stack which materially reduces the stack temperatures, thus lessening the natural draft.

THERMOTWISTERS.

1. Allowing for an efficiency of 75 per cent, what is the power required to drive a mechanical draft fan with a rounded-off conical mouthpiece 7 in. in diameter which delivers air at 2 oz. pressure with a velocity of 86 ft. per sec?

2. If the diameter of the above fan is 27 in., what is the number of revs. per min. it undergoes?

3. Air is driven through a pipe 12 in. in diam. 2000 ft. long. The difference in pressure between the two ends is 4 oz. How many lb. of air are delivered per min. and what is the velocity of the air and the horsepower required?

Solution of Thermotwisters—Seventh Lecture.

1. Steam at 100 lb. pressure is mixed with water at 100° F. The weight of the water increases from 10 to 11 lb. and its temperature rises to 197½° F. What is the percentage of dryness of the steam?

From steam tables for 100 lb. pressure I find

$h_0 = 298.5$, $L_0 = 887.6$, $W = 1$, $w = 10$, $h = 68$, $h_1 = 165.6$

We have

$$x_0 = \frac{h_1 (w + W) - wh + Wh_0}{Wh_0}$$

Substituting

$$N_0 = \frac{165.6 (10 + 1) - 10 \times 68 + 1 \times 298.5}{1 \times 887.6} = \frac{843.1}{887.6} = 0.95$$

2. The same steam is condensed in and discharged from a coil, its temperature becoming 210°, and 10 lb. of surrounding water rise in temperature from 100° to 204¼°. Find the quality of the steam.

On page 356, we have for the surface condensing calorimeter

$$X_0 = \frac{wh_1 + Wh_2 - wh - Wh_0}{WL}$$

and from tables we find

$h_1 = 172.45$, $h_2 = 178.3$, $h = 68$, $h_0 = 298.5$, $L_0 = 887.6$.

Substituting, we have

$$X_0 = \frac{10 \times 172.45 + 1 \times 178.3 - 10 \times 68 - 1 \times 298.5}{1 \times 887.6} = \frac{924.3}{887.6} = 1.041$$

Ans.

Hence since factor is greater than unity the steam must have been superheated.

3. What is the maximum percentage of wetness that can be measured in a throttling calorimeter in steam at 100 lb. pressure, if the discharge pressure is 30 lb.?

There must be enough heat liberated from the moist steam to superheat or at least to evaporate all the moisture in the steam when it gets to the lower pressure by throttling.

$X_0 L_0 + h$ = total heat in original steam.

$H = 1163.5$ B.t.u., or total heat required at lower pressure of 30 lb.

Hence

$X_0 L_0 + h$ must equal 1163.5.

At 100 lb. press. abs. $L_0 = 887.6$ $h_0 = 298.5$.

$\therefore 887.6\, X_0 + 298.5 = 1163.5$.

or

$$X_0 = \frac{1163.5 - 298.5}{887.6} = \frac{865.0}{887.6} = 0.976. \quad \text{Ans.}$$

4. Steam at 100 lb. pressure has added to it from an external source 30 B.t.u. per pound. It is throttled to 30 lb. pressure, its temperature becoming 270.3° F. What was the dryness?

On page 356, I find formula for added heat to be

$$X_0 = \frac{H + k (T - t) - h_0 - Q}{L_0}$$

From tables

$H = 1163.5$, $k = 0.48$, $T = 270.3$, $t = 250.3$, $h_0 = 298.5$, $L_0 = 887.6$,

Hence substituting

$$X_0 = \frac{1163.5 + 0.48 (270.3 - 250.3) - 298.5 - 30}{887.6}$$

$$\therefore X_0 = \frac{855}{887.6} = 0.964. \quad \text{Ans.}$$

5. In the last problem, the added heat is from an electric current of 5 amperes provided for one minute, the voltage falling from 220 to 110. What was the amount of heat added and the percentage of dryness of the steam?

In lecture we find 1 B.t.u. = 17.59 watts per min.

$$\text{Avg. voltage applied} = \frac{220 + 110}{2} = 165.$$

Volts × amps. = 165 × 5 = 825 watts per min.

$$\frac{825}{17.59} = 46.9 \text{ B.t.u. Applied.} \quad \text{Ans.}$$

$$\therefore X_0 = \frac{1163.5 + 0.48 (270.3 - 250.3) - 298.5 - 46.9}{887.6}$$

$$= \frac{838.1}{887.6} = 0.945. \quad \text{Ans.}$$

6. An engine consumes 10,000 lb. of dry steam per hour, the moisture having been completely eliminated by a receiver separator which at the end of one hour is found to contain 285 lb. of water. What was the dryness of the steam entering the separator?

Since 285 lb. of water was separated from 10,000 lb. of dry steam, the original weight was 10,285 lb.

$$\text{Hence dryness of steam} = \frac{10{,}000}{10{,}285} = 0.972. \quad \text{Ans.}$$

POLE-LINE TEST.

At the request of E. E. Burgess, assistant superintendent of the Central Oakland Light & Power Company, a number of those interested in pole line construction witnessed a demonstration of the Murray concrete base at the company's pole yards, on October 28th. The base consists of a 6 ft. concrete stubb, to which an ordinary 30 ft. pole is firmly bolted and is intended to obviate the rotting of the lower end of the pole which would otherwise be in direct contact with the earth. It can be used either for new lines or in replacing old lines. The test consisted in applying a measured pull and noting the ensuing deflection. All present were satisfied that its strength greatly exceeded any of the demands of the most extreme surface conditions.

NEW ELECTRIC COMPANY IN TOKYO.

The Japan Electric Light Company, of Tokyo, has been successfully floated. Subscriptions were closed on August 15. The number of shares applied for has reached 106,000, exceeding by 6000 the number offered. It will be remembered that this is the company which seeks to compete with the existing electric light undertaking in Tokyo.

CHARTS OF THE ATMOSPHERE.[1]

BY PROFESSOR ALEXANDER G. McADIE.

Readers of the Journal of Electricity, Power and Gas may not at first glance realize any possible connection between aviation and the general field of electricity and the distribution of electrical energy. As yet there have not been published any special articles describing in detail the electrical plant of a flying machine. Not yet has the art of aviation reached such a point, and yet it is undeniable that as the flying machine is developed there will be opportunity for the installation of electrical devices, both in the control of engines and in the determination of position and distance covered. Aside from the purely technical point of view our readers may in common with the rest of mankind have a general interest in the development of aviation, or in a broad sense the problem of transportation through the air. While much appears in the public press relating to the successful attempts of individual birdmen to perform certain feats, very little can be found regarding the genuinely scientific work which must underlie all sure progress. Professor Langley's paper on the Internal Work of the Wind was hardly noticed by the popular press and yet it is the very corner-stone of the modern science of heavier than air flying. Another epoch-making book of somewhat different character is this volume "Charts of the Atmosphere." It suggests to every meteorologist a somewhat similar book upon surface winds and ocean currents issued by Maury fifty years ago. The present volume however forces a recognition of even greater possibilities than the Navigational Charts promised; for while the ocean binds the nations, water is not man's natural environment and the air is. Man had sailed the seas for ages before the Physical Geography was written; but men are only now beginning to fly. And what the future holds for us no one can predict.

The charts in this volume are primarily designed for the use of aviators and aeronauts. So far as we know they are the first issued for this purpose. The results of the observations made for 20 years at the Blue Hill Observatory in exploring the air have been used to good advantage.

We notice at the outset the distinction between aeronauts and aviators, the former being balloon pilots and the latter pilots of flying machines heavier than air. Twenty-four charts are published, each accompanied with a page of explanatory text. The first chart gives relative height, atmospheric density and temperature. Heights are given only in English measures and it would be an improvement if in subsequent editions corresponding metric values were given.

[1]This review of Charts of the Atmosphere, by A. Lawrence Rotch and Andrew H. Palmer, 4to. 24 full page charts (John Wiley & Sons, New York, 1911), has been specially written for the Journal of Electricity, Power and Gas by permission of Professor Willis L. Moore, Chief U. S. Weather Bureau.

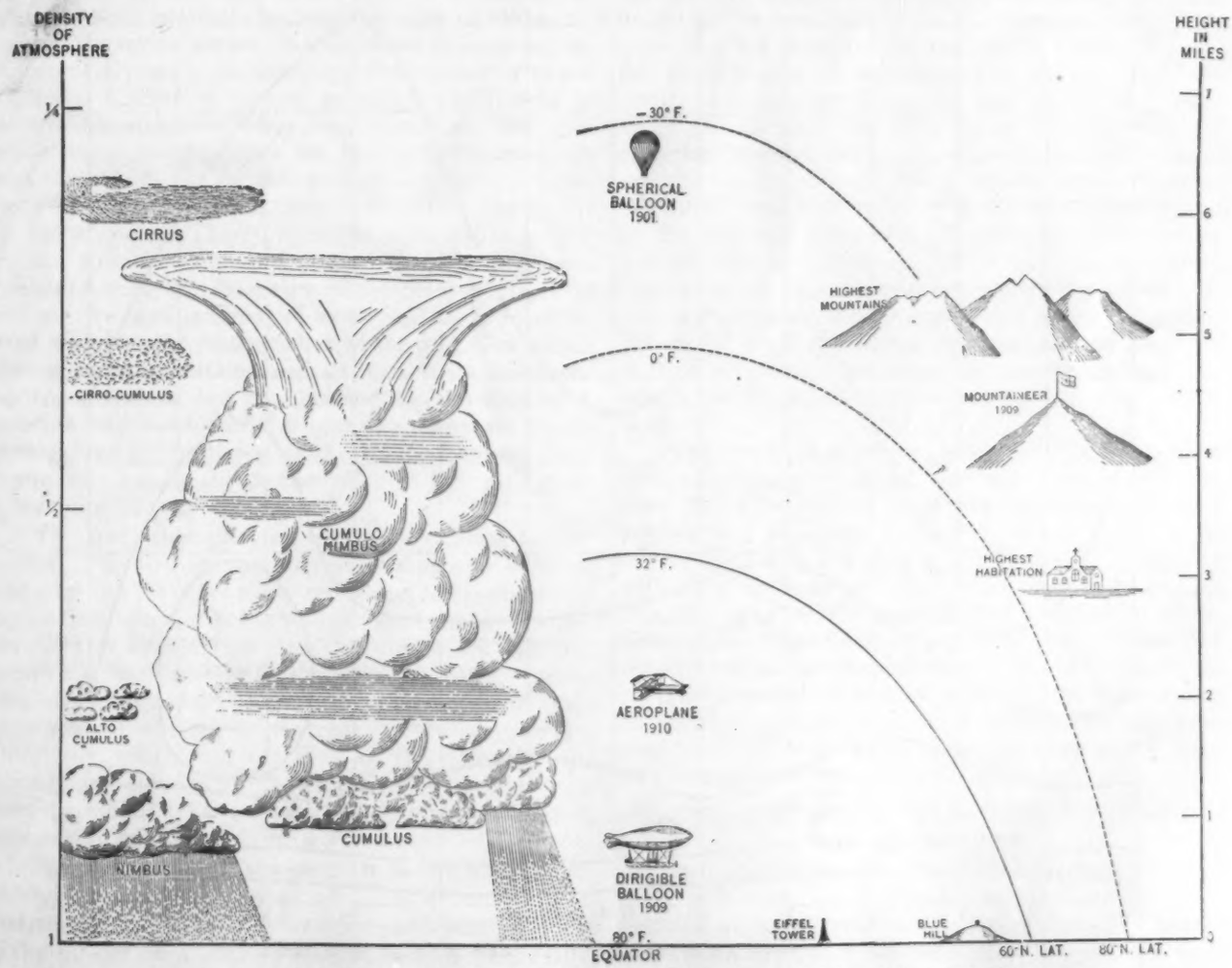


Chart No. 1. New Chart Graphically Showing Cloud Formation and Other Interesting Phenomena.

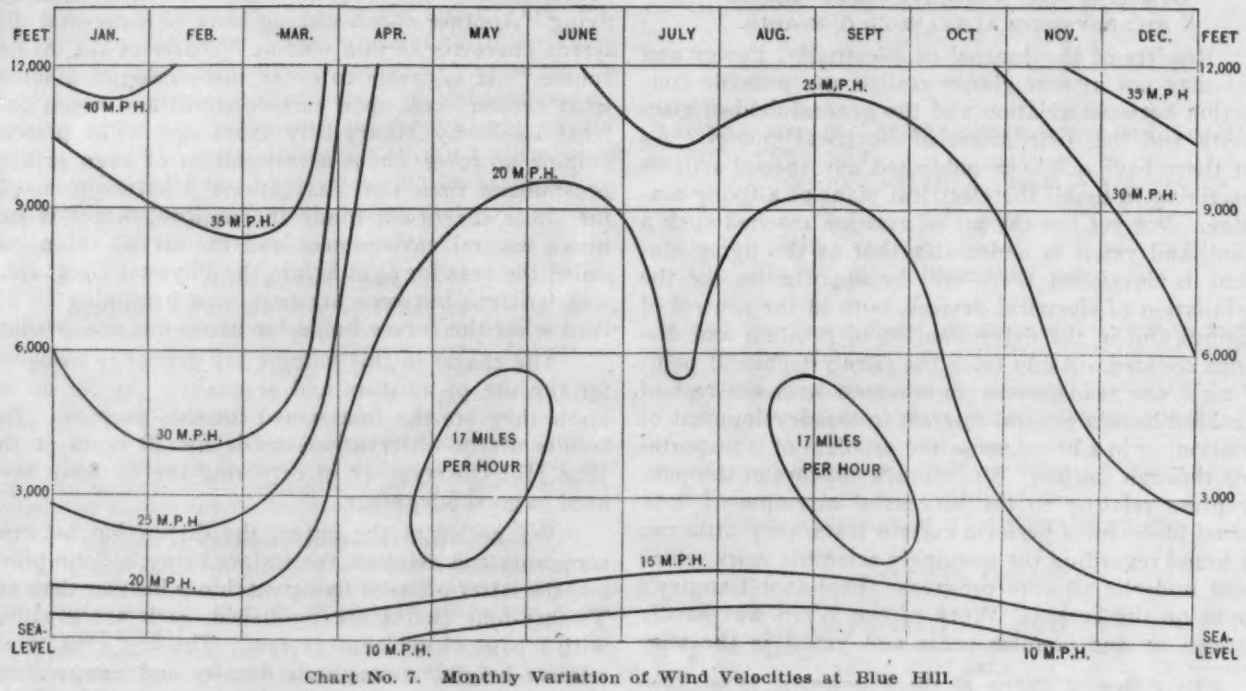


Chart No. 7. Monthly Variation of Wind Velocities at Blue Hill.

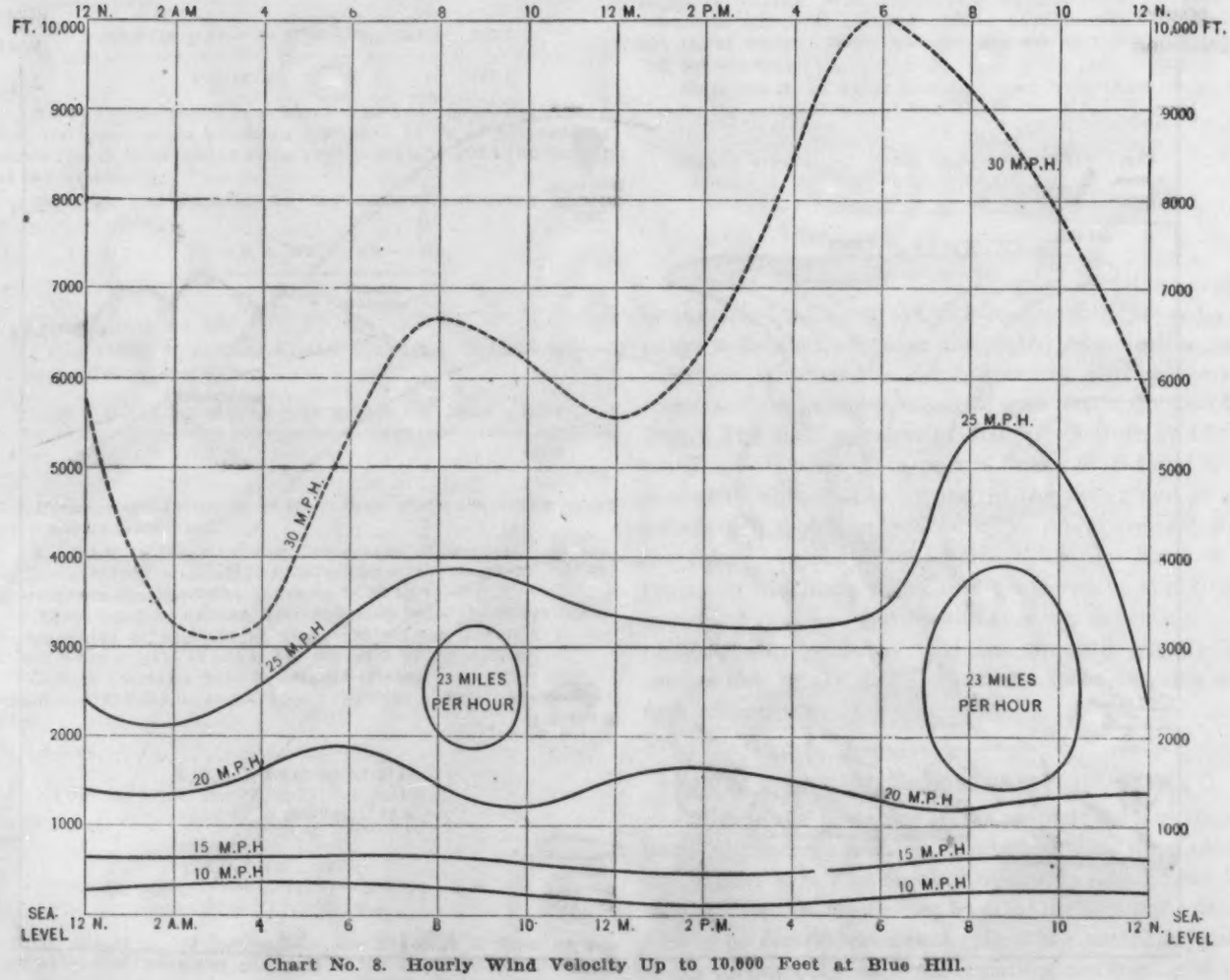


Chart No. 8. Hourly Wind Velocity Up to 10,000 Feet at Blue Hill.

Possibly a parallel column showing dynamic meters and equivalent pressures in millibars should be added. This opens up a matter of the utmost importance, namely, shall scientific units or units that at least make a pretense of precision be used now or shall we continue to use the old and cumbersome units and clumsy tables for conversion. This it seems to us is the only point on which the authors can be justly criticized. For in no place do they use anything but the old English units. Perhaps the authors felt that as the book was intended for American airmen, it was better to keep to the units in common use and that the introduction of absolute units would not be desirable at the present time. Mr. Rotch's work abroad however is so well known and his familiarity with kite and balloon data so great that it seems strange not to find incorporated in this work at least equivalent values in units that are comparable and have a scientific basis. And it is only a question of time before the new notation must be used, for the old units retard rather than make for progress. The arguments in favor of the new pressure unit; i. e., where the pressure is represented in units of force and the value of one million dynes taken as a standard and all pressure variations given in percentages of this are obvious, and the terms millibar, centibar and decibar instead of others are daily appearing in the literature of meteorology. Tables are already published for the quick conversion of geometric to dynamic values. The reason for introducing the dynamic meter is simply because the value of the acceleration of gravity varies. As Bjerknes pointed out in his recent Dynamic Meteorology the surface of equal heights is a slanting surface on which equilibrium is not possible under the sole action of gravity. On a surface of equal height above sea level a ball would roll from the pole to the equator and on a surface of equal depth below sea level it would roll from the equator to the pole. Therefore surfaces of equal height are not suitable as co-ordinate surfaces in problems connected with the dynamics of the atmosphere. To perform the same amount of work unit mass must be lifted higher at the equator than at the pole. The whole conception is interesting and an idea of its far-reaching consequences can be obtained by thinking of a dynamic map in which the height of a mountain would be measured not by the vertical distance from sea level to summit; but by the proper value of the work done in reaching the summit.

The text accompanying the various charts is well written. The diagrams are explained in an easy and natural way and there are many references to experimental facts which win and hold the interest of the lay reader. For the professional airman the charts are without question a "vade mecum." Of course the obvious weakness of all such charts from the professional air navigator's point of view is that they represent average conditions, which may not even be the probable conditions; and obviously they cannot be expected to meet the individual requirements. As Professor Rotch very wisely puts it:

"In the air as on the earth it is the unexpected which determines the result."

The charts are all valuable and are particularly strong in the matter of wind velocities at various levels, and the frequency of certain winds at certain seasons. Of course data are chiefly those relating to horizontal movements. Ascensional air currents and more especially the peculiar intermittent pulses which we do not yet adequately recognize nor automatically record are however not forgotten. In the text accompanying Chart 8 it is shown that intermittent ascending currents occurring during the day time are strongest in summer and when it seems to be nearly calm. The upper limit of these currents is usually shown by the tops of cumulus clouds in which descending currents may cause vortices about horizontal axes. Cumulus clouds therefore indicate "that although the horizontal velocity of the air below them is less than the average, the conditions are unfavorable for aerial experiments, especially near the clouds."

This we think is a matter of great importance to aviators and doubtless as the years go by we shall find that there are certain hours of the day or night when the conditions are favorable for aviation; and other periods when there will be an element of danger. The vertical stability of the air is greatest during the night.

Extremely interesting are Charts 21 and 22. The former enables the aerial navigator who has studied the pressure distribution from the daily weather map to forecast the changes of wind at different heights. In the case of low pressure areas the closer the isobars the stronger will be the wind and the more nearly parallel or concentric to them will be its direction, which turns to the right hand with increasing height in the front half of the low pressure and slightly to the left hand in the rear half. Chart 24 gives the aerial routes of the summer across the north Atlantic. Courses are indicated and appropriate lines show the distance travelled by each wind and the direction in which the airship must be headed to maintain the course; also the distances which the motor acting alone would drive it. These forces represented by the adjacent sides of a parallelogram give the resultant progress. This and the course to be steered are readily found by means of an instrument devised by Professor Rotch and constructed by Casella in London. When the wind and motor act together the resultant is their sum and when opposed, the difference. For simplicity the winds are concentrated in eight directions.

The work as a whole is a practical application of the knowledge deduced from many years' work at Blue Hill Observatory in the measurement of cloud heights and velocities, as well as other problems in meteorology which were not undertaken in connection with aerial navigation. The volume shows how valuable the work of the investigator becomes in directions never dreamed of when undertaken. The Observatory has thus furnished data of the greatest importance to aviators and aeronauts. The book marks an epoch in aerophysics. It is undoubtedly the forerunner of elaborate charts of the air, even as the Pilot Charts followed from Maury's work.

SOUTH AMERICAN ELECTRIC LINE AND DEVELOPMENT.

It is stated that the Hypothecary Bank of Uruguay will make loans in order to facilitate the colonization of large areas in the Departments of Rocha and Maldonado alongside the new electric railway, the construction of which will be initiated shortly.

RIGHT OF WAY AND LINE PROTECTION.

BY NORWOOD W. BROCKETT.

Transmission lines are generally constructed, either under franchises upon roads and streets or upon property owned by the company or upon which it has an easement. An ordinary easement should give to the company the right to construct, maintain, renew and repair its transmission lines and if it reserves to the grantor the right to use the property, such right should be restricted to uses which will in no manner conflict with the use by the company. The principal objection to an easement lies in the fact that if the owner of the fee loses his property by tax foreclosure, the easement is wiped out, leaving the company without its right-of-way. In practice, this necessitates an investigation yearly of the taxes upon the property covered by easements.

Through the efforts of this Association, the 1909 Legislature granted to the electric light and power companies, a right-of-way one hundred feet in width through all State lands upon the payment of reasonable compensation for the property so taken.

A public service corporation is entitled to the same protection of its property under the law, as any individual. The principal damage to its lines is caused by trees and blasting along the right-of-way. In purchasing a right-of-way or obtaining an easement therefor, a clause should be inserted in the instrument giving to the company the perpetual right to cut down or trim, upon land contiguous to the right-of-way, all timber or underbrush, which, in the opinion of the company, are or may become a danger or menace to the maintenance of its lines.

In cases where the pole line is set along the edge of a county road under a franchise, a constant annoyance is caused by the interference from the branches of trees upon private property contiguous to the road. The company, under its franchise, has the right to occupy the position which it does. The owner of the property has a right to cultivate fruit and shade trees upon his own property and when these rights conflict, trouble follows. The writer has, upon various occasions successfully maintained the position that when the overhanging of trees upon the county road conflicted with the lawful easement granted by the Board of County Commissioners, that the trees became a nuisance and could be trimmed in such manner as not to interfere with the lines. However, if the poles are placed upon the extreme edge of the road and the cross arms and wires overhang the property, the company has no legal rights. Where poles are set in this way, an easement should be first obtained from the property owner, giving to the company the perpetual right to overhang his property. Every man has a right to use his property in any legal manner in which he sees fit, so long as he does not invade the rights of the owner of other property. An owner has a right to blast stumps from his land, but he has no right to blast them in such manner as to injure transmission lines and if he does so, he is liable in damages. The right to recover damages and the actual recovery thereof are, however, two different matters, as the blasting is generally done by some irresponsible contractor, against whom a judgment would be worthless. Patrol men should be instructed to keep a careful watch upon all operations in the clearing of land and special notices given them to serve upon all property owners about to blast along transmission lines, the notice reciting the danger to life and property in the event the line is broken. As a general rule the owner is reasonable in the matter and will blast at a certain time and in a certain manner. In the event he will not do so, the court will, upon a proper showing, grant an injunction restraining the owner from doing such blasting. In a suit for the collection of damages for the negligent breaking of a transmission line by blasting or otherwise, where the company has suffered considerable loss to its machinery and service, in addition to the time and material used in repairing the line, the question arises as to whether the person causing the damage could reasonably have anticipated that the mere breaking of the wires would have occasioned such a serious loss. To protect against this, the company should post a notice upon each pole, giving the voltage and stating concisely the danger to life and property which may be caused by the destruction of the lines. This notice should also state that the wires are absolutely safe, unless interferred with, so as not to alarm the public in emphasizing the danger. These notices also have considerable bearing in the case of injury to the public.

DISCUSSION PAPER ON PUBLIC SERVICE COMMISSIONS.

H. W. Crozier: How much control do you think the Commission would be able to exercise over the municipalities? Assuming, for instance, that it was a case of another company, not a municipality, but an ordinary organization going into the field as a competitor? Is it understood that the Commission could refuse permission to that competitor, or could allow both one and the other?

Max Thelen: That of course depends upon what view the legislature will take of the matter. A statute has to be drawn up before any of the provisions of the constitutional amendments will be effective; and I cannot say before hand whether the legislature will confer upon the State Commission the power and duty to pass on these new corporations or whether it will not.

H. W. Crozier: In the states of Massachusetts, Wisconsin and New York what about the power of a municipality to go into the business?

Max Thelen: In Wisconsin the municipalities have the power, and a great many do; in New York to a smaller degree, and in Massachusetts also to some degree; so in those states too we find quite often the situation in which you have a municipally owned plant and a privately owned plant operating in the same city.

H. W. Crozier: It has been admitted I believe (I am not sure of my point there) but it has been stated here in San Francisco that it will be absolutely necessary for us to purchase the Spring Valley Water Works before we can go into the water business—not so much that it is required by law, but as a matter of expediency. It seems to me that is a good provision, not to ruin the other man's property if the city were to go into the business itself.

The particular case I am driving at is where there is an electric light company which is giving excellent service, and the rates are low. For some reason or other the city wants to go into the business itself now. We all admit that it is proper they should buy the company out.

Max Thelen: I think that is a sensible thing to do.

H. W. Crozier: But apparently, as far as I can see, they are going into the business and compete with them like anyone else.

Max Thelen: I don't see how you can prevent that unless you take away from the city the power to own its own plant. If the cities are to have the right to own their own plants then of course there may be cases in which the cities themselves are unjust, and you are going to have unjust results to existing corporations, but I think you will find that the cities will generally acquire the existing plants.

H. W. Crozier: They have shown a tendency in some cases.

Max Thelen: They are contemplating that apparently in this city with the water.

W. G. Vincent, Jr.: May I ask if any of these Commissions set maximum rates or set rates? I think that would answer that question. If they set rates, they could prevent the municipality charging an unjustly low rate.

Max Thelen: In answer to your question, I would say there are some commissions that fix a maximum rate. For instance the Georgia Commission fixes maximum railroad rates; but the Commissions of Wisconsin, Texas, Massachusetts, fix the rate. Now I am afraid that you are laboring under a little misapprehension. If this constitutional amendment passes, the State Commission won't have the right to fix the rate of a municipally owned plant. I want to say this in all frankness. The amendment provides, at least by implication, that the State Commission shall not have power over a municipally owned plant. It says "Every private corporation," and by saying "Every private corporation" of course, by implication, that excludes a public corporation, a municipally owned corporation.

A Member: I would like to ask if in some of the Eastern States having public service commissions, if those commissions have the right to fix the rate on municipally owned plants?

Max Thelen: Some of them from Wisconsin have. I am not sure whether New York has; I don't think it has; but I know Wisconsin and Massachusetts have the right to fix rates. I think that Wisconsin and Massachusetts are the only two states in the Union that give to the State Commission the absolute power to regulate and control a municipally owned plant; but with that qualification Wisconsin permits the city authorities to do nearly everything they wish to do except to fix a rate, and what the municipalities do sticks unless there is an appeal to the State Commission. Matters of services and facilities are regulated by the city authorities, and the city ordinances on these matters prevail unless overruled on appeal to the State Commission.

F. F. Barbour: In regard to the indeterminate clause, in Wisconsin, if I am not mistaken, they allow corporations which have franchises to surrender their franchise, and come under the terms of that clause. Do you know what proportion of the corporations have done that?

Max Thelen: That statute was first passed in 1907, and the corporations were given one year, I think, within which to bring themselves under its terms, and surrender their franchises; and then another year, and another year, and that brings them up to the present year; and only 25 per cent have surrendered their franchises and brought themselves within the terms; but the last legislature took the bull by the horns, and declared all corporations subject to the new law with respect to the indeterminate franchise; so in Wisconsin every franchise is an indeterminate franchise. That operates very largely to the advantage of the existing corporations, and consequently none of them have complained. Of course the reason why the state wanted to do that was because the municipalities then acquired the right to purchase these companies at a valuation to be fixed by the Commission with an appeal to the courts.

S. B. Charters, Chairman: Is there any further discussion? I had hoped possibly we might have an expression of opinion from some of the corporation side of the house, that is, people who are going to be most directly and immediately affected by the rulings of any such commission as this is proposed to be.

I noted in the last Electrical World coming over tonight a few points in regard to the operation in Wisconsin. As the speaker said, the corporations were very much afraid, so to speak, of the operation of this Commission when it first took office; but since then the public opinion, and the opinion of the corporation people likewise, has practically entirely changed. The result has been in every way favorable to the corporations, that is, in this way, that unjust discrimination to a very large extent has been abolished, and there are corporations which had been forced by franchises and other powers conferred on the cities, to make unduly low rates. In such cases the Commissions raised them. Indeed it has been found that an efficient commission of this kind has been of benefit to everybody concerned. In the State of Wisconsin it has been found that the saving in railway fares would amount to a little over a million dollars a year, and the saving in freight rates is approximately $800,000; that is approximately two million dollars a year so far under the operation of the Commission saved to the people.

On the other hand, it has been found that the corporations have been given a much greater security in the eyes of the investing public. In a great many places there is to-day a feeling of distrust as to what the outcome is to be in regard to certain things, whether we may have cut-throat competition between various companies, and whether a municipality may come in and enter into competition with a corporation, reducing the value of its securities. Under those conditions there is a feeling of insecurity as to what the value of public securities should be. In almost every case the corporations in Wisconsin have not only shown an increased income, but they have also shown an increase in net profits, so we can see that it works both ways. There has been a saving to the people in actual rates in a great many cases; and owing to the increased security given the corporation a possible increase in income and net profits; so I think if we might hope to have a Commission which would operate as efficiently as in Wisconsin very favorable results might be achieved. Of course the whole thing hinges on the efficiency of the Commission which is appointed.

A. H. Halloran: All those present understand that the State Commission under discussion is something that is proposed; but going ahead on the assumption that this Commission is established I would like to know if the men interested in the Commission have any preliminary plan as to the method in which the work is to be done. Mr. Thelen has said there will be five Commissioners, and thinks there will also be a secretary. Now in regard to the engineers that are to do the work, and the various statisticians and evaluators, has any general scheme been mapped out as to the way in which they will tackle the various problems, the order in which the business will be taken up, and also in regard to the compensation which is to be paid?

Max Thelen: The Commission itself, as far as I know, has not made any general plan at all. I have a plan in my head, and if you gentlemen are interested I will give it for what it is worth, although I have absolutely no assurance that the Commission will adopt it.

There are to be five Commissioners and a Secretary. Of course there would be an administrative portion of the work, which would consist of the commissioners, the secretary, the stenographers and clerks. In addition to that there would be a rate department. There is one already consisting of a rate expert and three assistants. The rate expert gets $3,000 salary, and the assistants get a salary—I am not sure whether it is $2,000 or $2,400. Now in addition to that it will of course be necessary to have an engineering department.

That will be one of the most important departments of the Commission. The Commission has already selected its engineer. It was very fortunate in the selection. The Commission secured the services of R. A. Thompson, who was for nine years the engineer of the Texas Railroad Commission and as such made the valuation of the railroads in Texas. In addition to that he helped start the work of the Oklahoma Commission, and was highly recommended by Franklin K. Lane, of the Interstate Commerce Commission. He is a man who will give his entire time to the service—and I want to say that all the men employed by the Commission give their entire time to the work. Take my own case. When I was appointed I made up my mind that I would give every bit of time to the Commission; and that is the same with the engineer and with the other employees of the Commission. If this Commission is to do effective work a man must be "Johnny on the spot" all the time.

The engineer will have various functions to perform according to this mythical plan I have outlined. First he must make a physical valuation of the railroad properties in the State, and that function probably will extend later to public utilities, at least to such of the public utilities over which the Commission will have control.

The second branch of his work will consist in what we may term inspection work, that is, to inspect the physical properties of these corporations. Massachusetts, for instance, has ten inspectors whose sole duty it is to inspect the condition of the railways of the state—the electric railroads and the steam railroads, to inspect the tracks, the equipment and the engines. They go out whenever a complaint is made as to any of those matters and investigate the subject matter of the complaint. They go out whenever an accident takes place and investigate all the facts in connection with the accident, and make their recommendations as to how those accidents can be avoided in the future. That would be inspection work as applied to railroads.

Now, as applied to Gas, Electric Light and Telephone companies, I think we ought to follow as far as we can in the footsteps of Wisconsin. Wisconsin has divided the State into four sections, and in each there is a man who is an electrical inspector. He inspects the electrical plants, sees whether the voltage is kept up, sees whether the testing of the machines is accurate, and looks after plants in his district in matters of the service. Those men are out in the State all the time. They come in every month or two and have a powwow in the office, and go out again. There is a gas inspector who inspects all the gas corporations in the state. They have a telephone inspector also, and have done some very interesting work along those lines. He has made a test of 112 calls in each of a very large number of cities of the State in order to see how quickly Central answers, and the party is reached at the other end, how many times Central tells him that the line is busy or to call again; and these tests have been tabulated and sent to the Telephone corporations. Some of them had a good showing and others did not; and the result has been that those that did not have a good showing have been trying to improve. Mr. Thompson is a man who has done both kinds of work, that is, both physical valuation and inspection work.

In addition to that, under this plan of mine that I dream about once in a while there should be established here in this Commission a department of statistics and accounts, as they have in one or two of the leading states. Very few states have paid proper or sufficient attention to this matter of statistics and accounts. It would be the function of this department to examine all the reports which come in from the different railroads and public utilities, to see whether they are accurate or not. It would be the function of the department to establish a uniform system of accounting in so far as it could work in this state. The Constitution ever since 1879 has made it the duty of the Railroad Commission to establish a uniform system of accounts as to railroads; but I haven't been able to discover in any of the archives of the Commission that anything along those lines has ever been done. This department of statistics and accounts would be of great assistance to the Commission in case of a contest in rates, because that department would then be called upon to get the necessary statistical information for the Commission, and also in the matter of stocks and bond issues. It would be called upon to give the financial facts just as the engineering department would be called upon to give the physical facts. If we had those departments—the administrative department, the rate department, the engineering department and the department of statistics and accounts, with good men in charge, who would give all their time to it, and be "Johnny on the spot," I think the Commission ought to be able to do good work.

Now as to the question of salaries, the Commissioners are to get $6,000 apiece. New York pays $15,000, but that is exceptionally high. New Jersey pays $6,000, Massachusetts pays $6,000 to the chairman and $5,000 to the Commissioners, and Wisconsin pays $5,000. The rate expert, as I have said, gets $3,000; the secretary $3,000; the engineer $5,000, and we feel ourselves particularly fortunate in getting an engineer of Mr. Thompson's experience who will do the work for $5,000 a year for two years. As to the salary of the head of the department of statistics and accounts I suppose it would be about $3,000. That is what most of them receive throughout the country.

I want to say that this is all a plan running in my head, and has absolutely no official sanction, and can not tell whether the Commission will be disposed to take my view of these things or not.

C. L. Cory: There are one or two things that I think deserve some fuller discussion than they have had up to the present time. The first is in regard to the relations of a public service commission having to do with the control of a public utility, and a municipally operated public utility. Now the fact is that in the State of Wisconsin and in Massachusetts, and to a certain extent in New York, the municipally operated public utility is under exactly the same control as the private public utility. That brings me to another point. Much has been said in this general matter of the control of the public utilities regarding a uniform system of accounting. Now a uniform system of accounting as proposed by many of the Commissions I know as an absolute fact is impracticable. They are not any use. They have been discarded and not used by the corporations, for the very reason that those accounts do not conform either to the accounts required from the auditing department, or the accounts that are of most value from the standpoint of engineers, as most of us as engineers know. I personally believe, if I am able to read clearly the decisions of the good Commissions—and I want here to say without any hesitancy that there are good State Commissions for the control of public utilities, and there are some that do not deserve any adjective that we may with propriety use in an audience of this kind. We are all much given to thinking of the commission that has to do with the control of a public utility, whether it be a railroad or any other public utility, making that synonymous with the Wisconsin Commission. Would that it were so. You will find in the five volumes that have already been printed of the Wisconsin commission's proceedings, not only a general discussion from the standpoint of equity, but concisely in the back of each of those volumes the specific decisions that have been rendered by the Commission, and those are the valuable things: those are the things that unquestionably need to be taken into consideration when we are considering the problems of the control of public utilities. There is one point which has impressed itself upon me which I do not believe has ever been taken up by the public utility commissions. If it has I should be very glad to have Mr. Thelen tell us something about it, be-

cause he has had the opportunity recently of learning what has been done in many of the states—that is the labor problem. We are taking up now all over the United States the matter of the rates or the returns, the receipts of the public utility corporation. Unless I am very much mistaken the relation of the employer to the employed has absolutely been left to the employer. That problem has been left, unless I am very much mistaken, entirely to the corporations themselves. Their losses, the loss to the people, the loss to the laboring man, the loss to the employed, have been exceedingly great. I have had it suggested to me very recently that possibly the Public Service Commissions of the broadest type might assist materially in adjusting some of the difficulties, perhaps by arbitration between the employers and the employed. If that is possible, if it is not done at the present time, if it is possible to develop that in the future I think it will be distinctly constructive work.

There is one point I wish to mention. If it were not that we are here a group of engineers, and we have been complimented by one of our State officials in coming here to give us this discussion and valuable information, I should not mention it, but there is nothing gained by not being frank, and that is this: I believe it is true that the Commissions that do not deserve the commendation such as is given to Wisconsin and Massachusetts have been wrecked upon one rock, and that is the rock of politics. I do not believe that as engineers any of us will for one moment allow that any improvements in the science which has developed in engineering, that the growth of communities, that the value the public service corporations have given to communities, has ever been assisted by politics. I do not mean politics in the higher sense; I mean in the selfish sense. True, all facts must be obtained no matter what the result may be. I am inclined to think that some commissions, whether they be for the control of public utilities or Railroad Commissions or otherwise, might be of even less service to the community than the commission which consists entirely of gentlemen of leisure, and which employs a pretty—but very indiscreet—stenographer. I think that a commission that is going to conduct this work as some of them have—purely on the basis of politics, and be controlled by politics, will not be constructive; they will not deserve the co-operation of engineers who, I believe, it will be found are as interested as any people in the development of the proper relation to the public utility corporation and the people.

I am glad Mr. Vincent brought up the point of the indeterminate term as regards franchises. As you know, we in this state have had considerable difficulty regarding the value of a franchise in valuing a property, and then immediately considering that franchise on a little different basis for taxation purposes. I think the time is come when we must cease indiscriminately terming something a franchise which as a matter of fact is nothing more or less than a permit. The permit given in the State of Wisconsin of course, as Mr. Thelen very clearly set forth, is to prevent unwise and expensive competition. That sort of thing is more or less like an exclusive franchise that does exist in some cases in cities and counties of California; but in general the public utilities other than the transportation companies that are said to possess a franchise do not in reality possess a franchise; they simply possess a permit; and another corporation can with the greatest readiness obtain a similar permit, and go into competition with the old corporation, and thereby entail upon the people in general a much greater expense than if one corporation were allowed to go ahead and that corporation properly controlled.

Of course I am not at all familiar with the proposed amendments. I think we are especially to be congratulated that Mr. Thelen has set forth some of the important points in these amendments; and we as voters are especially interested in that, and I should suppose a little more interested and a little more capable of appreciating what it will mean. I cannot quite see for myself, however, how a large public utility corporation which is doing business in a great many cities, and at the same time doing business in communities outside of the cities, can with any degree of success, be controlled by the different bodies. It happens that I personally have had to do within not very many years with the work incident to the adjustment of rates—one in regard to the Telephone company, the other with regard to the rates for electrical service in a small town. In each case we were confronted with this problem: the local business of the city in either case was but part of the main corporation. How is it possible, if you like to put it plainly, how is it possible for the City of San Francisco or the City of Los Angeles by any method, by any board of control, to adjust rates with the degree desirable if in that city there be a company which is not merely doing a local business in that city, but doing an extensive business in other cities as well? Of course that is clear to you because of our long distance transmission of power that often makes the case. Even with our gas utility the same is true; and of course as to the other utilities we again find the same difficulty. The areas that Mr. Thelen has drawn on the board showing the relative importance of the control of the State, as contrasted with the control of certain cities, does not quite satisfy me.

Max Thelen: I am willing to put the line anywhere; in fact I think it ought to be moved further up. I was using that as a matter of illustration. I think the triangle ought to be larger considerably as compared with the rest of the square.

C. L. Cory: As engineers we are very much inclined to deal with volumes rather than areas; and if we will take any division of that area that we have there, and consider the litigation and the cost to the consumer—I am willing to go back where we belong—the cost to the consumer of everything that is involved to adjust those rates, I think the form of the small area that might be put in that triangle would be greater than the volume that you might get in any other area; because how can we have two different bodies, with no co-operation of the one with the other, attempting to control a rate which is one which can only be controlled by a body large enough to cover the activities of the entire corporation.

Far be it from me to indicate that the proposed action is not very wise. We as engineers know that compromises are absolutely necessary. The problem that we can solve with the logarithm table or the stick is not worth while. We must deal with problems as a whole and with the ultimate result sought to be obtained, taking everything into consideration. But as an engineering problem, as a problem which particularly interests the engineer, and going back to the East, where we get out best advice and constructive work, I am somewhat skeptical about any method of control of rates where the matter is divided between a wise and well organized State Commission and another local body, no matter what it may be. As I say, I think we are extremely indebted to Mr. Thelen for coming here this evening; and in any capacity I think the Institute of Electrical engineers can assure him that any assistance that is possible, whether it be from those who are actively interested in the work of the corporations, or those that are not so directly interested, whatever may be for the building up of a wise and constructive commission, the development of a relation which shall be harmonious between the serving companies and the people to be served—not like he indicated in the case of the street railroads of New York City—but a wise co-operation, mutual respect, mutual confidence, I think he can be assured that all of us who are in the Institute and represent the Electrical interests, will be only too glad to do anything we can. (applause).

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Charts of the Atmosphere

Elsewhere in these columns will be found a review written by Professor Alexander McAdie, of the U. S. Weather Service, on a recent publication entitled "Charts of the Atmosphere." The whole world stands awe-inspired with the gigantic strides being made in aeronautics. Awe-inspired for two reasons. First, the record-breaking sacrifice in life on the part of the pioneers in this science, and second the untold possibilities still to be accomplished make men bow their heads in silent recognition of the unfolding of the great designs of their Creator.

It is doubtful if ever an advance in scientific work was accomplished with such frightful loss of life. Daily the record of death solemnly tolls the treacheries encountered in hitherto unstudied air-currents.

Of material aid are charts that can foretell atmospheric conditions. For instance it has been found that intermittent ascending currents occur during the day time, being strongest in summer and in nearly calm weather. Their upper limit is usually shown by the tops of cumulus clouds in which descending currents may cause vortices about horizontal axes. Cumulus clouds as shown in Chart I, therefore, indicate that although the horizontal velocity of the air below them is less than the average, the conditions are unfavorable for aerial experiments, especially near the clouds. During the night the vertical stability of the air is greatest.

Like the advent of the new born babe into the world, no great advance is ever made or new creation formed without intense suffering or even loss of life on the part of the human race. Silently and reverently let us bow our heads when we read the daily record of accident and death in aeronautics. The divine mind of man is at work in the greatest advance ever known to civilization. Painstaking care and investigation will eventually equip man with powers well-nigh those of the great Creator himself.

Aesthetic Side of Engineering Structure

A description of the new Coleman Plant of the Northern California Power Company appears as the leading article in this issue of the Journal.

It has been a rule in carrying out engineering work of this kind, especially at points distant from towns and cities, to leave the aesthetic side of the construction, the question of appearance and finish fitting for the location, as entirely secondary or altogether absent. Many engineers cannot see the importance of this point, for the simple reason that plants are designed with a prime object of accomplishing the development that is in view, with little thought of the many influences which may be brought to bear to invalidate successful operation, but which

may be overcome by the careful design of details. It may, for the moment, seem odd to think that the appearance of a power station would have any effect upon the future successful and efficient operation of that station. Such, however, is the case, as it affects the imagination and eventually the lives of those who must go through the daily grind which accompanies the operating of a plant of this kind. As it costs practically no more to give a pleasant and agreeable finish to building and surroundings, it pays well to consider appearances on the exterior as well as proper arrangement in the interior. The location of the Coleman plant is picturesque, situated as it is, in a shallow canyon, and surrounded not by heavy forests, but by more or less scrub oak timber and brush.

Much gray matter on the part of engineers is being wasted of late in considering all points leading to a correct valuation or factor to allow for depreciation. We have formerly commented in these columns concerning the factors certain evaluation experts allow for depreciation in certain classes of installation, and have drawn attention to the fact that these factors seem to vary in different plants, although the class of machinery may be identical. Undoubtedly the attitude of the management, the operating force, and of all even down to the humblest man on the job, has something to do with the wear and tear of a plant, and the consequent determination of the "factor of roughness" to be allowed in each individual case. Canguillet & Kutter found in hydraulic measurements that the flow of water depends upon a certain co-efficient of roughness in the bed or channel conveying the water. A canal made of well-planed timber or neat cement was found to have only 1/4 to 1/3 the coefficient of roughness in the case of canals or rivers in bad order.

And so it is in the case of the power house. Unconsciously, inspiring surroundings coupled with an exterior trim of the building itself designed in synchronism and harmony with nature will show its effect by producing cleaner, more earnest and caretaking attendants, and this will result in the material lessening of the co-efficient of managerial roughness to be applied in estimating the personal wear and tear on machinery and its consequent depreciation.

Municipal vs. State-Wide Control

A few issues back we called attention editorially to certain ugly features in California's new constitutional amendment No. 47.

The special session of the California legislature to be called for early in December will doubtlessly pass a new railroad commission act to carry out the provisions of Senate constitutional amendment 47, which authorized the legislature to confer upon the commission complete powers of regulation and control over all the public service corporations of the State, except such powers of control as the incorporated cities and towns now have and do not vote to confer upon the commission. The immediate result of this legislation will be that the incorporated cities and towns will keep the power of control which they at present have, being principally the power to fix rates and to exercise certain police powers, while the board of railroad commissioners will be vested with the entire residium of power to regulate and control such corporations.

Under these circumstances, the following reasons are urged in favor of having the incorporated cities and towns confer their powers upon the railroad commission.

I. The commission can do better work than the cities. Most cities do not have the money with which to secure expert engineers, rate men, and statisticians or accountants for the purpose of securing the information necessary to use as the basis for fixing rates. The State Commission will have a corps of trained experts who can do this work. The cities also often do not have the legal talent with which to enforce their orders in case they are attacked in court. The city of Berkeley recently confessed judgment in an injunction brought against it by the People's Water Company to restrain the enforcement of an ordinance reducing water rates, for the reason that the district attorney did not wish to go ahead without the assistance of high priced lawyers, and the mayor and councilmen were unwilling to supply the money to engage the additional lawyers.

2. Divided control will be confusing. The cities in the first instance will retain the power to fix rates. As to these same corporations, the State Commission will have the power to control issues of stocks and bonds, to regulate service and to exercise every other kind of control, except the fixing of rates and police regulations. If these same corporations extend beyond the city limits, the commission will have the power to fix rates for the service outside of the city, while the city fixes the rates for the service within. This division of responsibility will produce a certain amount of confusion, and it would be better to have unified control.

3. Control by the commission will produce more just results. In many cities, very little or no attention is paid by the city authorities to the fixing of rates, with the result that the corporations do about what they please, a result manifestly unjust to the cities. In other cases, men are elected to office on a pledge to establish a certain rate for one commodity, such as gas or electricity or water, without any investigation into the fairness of the proposed rate, a result clearly unjust to the corporations. The State Railroad Commission is not a party in interest, and its decisions are more likely to be just both to the cities and the corporation than the decisions of the city councils.

4. State control will result in uniform and consistent system of regulation. As contrasted with a system under which as many results may be established as there are cities exercising power over the different public service corporations, it is evident chaos and confusion must be the result.

5. The experience of other cities favors unified State control. This is the system which is working so well in New York, Wisconsin and Massachusetts. Within the last year or two, it has been adopted in Washington, New Jersey, New Hampshire, Ohio, Kansas, Nevada and Oregon. No other State provides for the divided authority which we have in California.

PERSONALS.

Mr. Cleavenger, representing the Phoenix Glass Company, is at San Francisco on a tour of the Pacific Coast.

F. B. Gleason, Pacific Coast manager for the Western Electric Company, is making a short eastern trip.

Thomas Bibber, representative at large of the Jovian order, and who travels for Edwards & Co., is at San Francisco.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is visiting the Seattle office of that corporation.

K. G. Dunn, with Hunt, Mirk & Co., has returned to San Francisco from a tour of Southern California on engineering business.

W. C. Kennedy, president of the Ontario Gas Company, of Ontario, Canada, is a recent arrival at San Francisco on a tour of the Coast.

S. K. Colby, manager of the electric railway department of Pierson, Roeding & Co., has returned to San Francisco after an extensive eastern trip.

Carl J. Young, an engineer in charge of the construction of a large irrigation dam in Nevada, is among the recent arrivals at San Francisco.

O. A. Hoff, formerly district engineer of the Pacific Telephone & Telegraph Company at Portland, has been transferred to the Seattle District.

A. F. Moulton, formerly district engineer of the Pacific Telephone & Telegraph Company at Seattle, has been transferred to the Spokane District.

Emory E. Smith, of the firm of Smith, Emery & Co., with offices in San Francisco and Los Angeles, has returned to San Francisco from the south.

Henry H. Thedinga has been appointed district sales agent of the Century Electric Company of St. Louis, Mo., with offices in the Central Building, Seattle, Wash.

C. H. Smith, who is connected with the executive department of the Westinghouse Electric and Manufacturing Company at East Pittsburg, is at Los Angeles.

Charles W. Waller, a former manager of the Great Western Power Company, has returned to San Francisco from London, where he went on important business.

A. H. Kling, representing the Detroit Fuse and Manufacturing Company, of Detroit, is at San Francisco, where the agency is carried by the Dodds-Caffray Company.

Fay Woodmansee, C. J. Davidson and E. O. Sessions have opened offices as consulting civil, electrical and mechanical engineers in the First National Bank Building, Chicago.

W. H. Wissing, formerly with the Union Light & Power Company of St. Louis, Mo., arrived at San Francisco this week to take the position of sales manager with the Sierra & San Francisco Power Co.

A. C. Balch and W. G. Kerckhoff, who are interested in the Pacific Light & Power Company and in the San Joaquin Electric Power Corporation, have been spending a few days at San Francisco on business.

Jesse Yount, the master mechanic, and John Finnegan, purchasing agent for the United Railroads of San Francisco, are again at their posts, after attending the National Street Railway Convention at Atlantic City.

O. H. Ensign, chief electrical engineer of the United States Reclamation Service, addressed the students of Throop Polytechnic Institute on October 23 on the work of the reclamation engineer. The Salt River project and others were described.

K. E. Van Kuran, assistant manager of the Westinghouse Electric and Manufacturing Company's Los Angeles office, is at San Francisco. He was formerly at the head of the switchboard division in the detail and supply department at the East Pittsburg works.

H. L. Walthers, formerly manager of the Yreka Railroad, is now manager of the Siskiyou Electric Power and Light Company and its subsidiaries. He has charge of the plants recently acquired from the Rogue River Power Company, with headquarters at Medford, Ore.

Thomas Pumfrey, formerly engineer of maintenance of way with the Portland, Light & Power Company, Portland, Ore., is now a member of a railway contracting firm engaged in railway construction for the Harriman interests. Mr. Pumfrey was presented with a gold medal by his former associates in the Portland Electric Company upon his resignation.

Sidney Sprout, electrical engineer, has returned to his San Francisco office after making a hyrdoelectric investigation on Smith River, where James H. Owen proposes to develop several thousand power for transmission to Crescent City and elsewhere. Three power sites are available, which, possibly, could be developed to the extent of 2,000 h. p. each.

Philip S. Dodd, secretary of the Commercial Section of the National Electric Light Association, is making a hurried trip throughout the Pacific Coast. He was entertained at San Francisco on October 30 and 31, leaving for Portland and Seattle on Tuesday night. He will return to San Francisco before going East and will address the electrical men at a luncheon on November 7, on "Cooperative Spirit."

A. C. Balch, of Los Angeles, vice-president of the San Joaquin Light & Power Corporation, has been at San Francisco during the past week. In speaking of the remarkable development of the San Joaquin Light & Power Corporation, Mr. Balch refers to the fact that the San Joaquin company now have on their system the largest artificial lake in California. This lake is formed by the immense rock-fill dam, the construction of which has been completed during the past summer by the engineering firm of J. G. White & Company, Incorporated. The dam, which impounds over 50,000 acre feet, has a maximum height of about 130 feet. Mr. Balch has just received the final reports of tests made on the new 20,000 h.p. power plant, which was also built by J. G. White & Company. Two of the units in this plant have been running for about a year, and two have been recently installed and put in service. Mr. Balch considers that this plant is a model of its kind, and that its design and the efficiency of the apparatus have combined to produce a power station of the very highest efficiency of which he has any record.

OBITUARY.

J. J. Ferrier, office engineer with the Southern Pacific electrical department, killed himself at his home in Fruitvale, California, on October 29. Mr. Ferrier was but 29 years of age and held an important position with the company which was based upon his previous experience with the New York Central Railroad. No reason is known for his suicide and his many friends are grief stricken. He leaves a wife and child.

Professor John James Montgomery, of Santa Clara College, who laid claim to being the real discoverer of modern aviation, and who was also noted as the inventor of an electrical rectifier now in commercial use, was killed October 31 by a fall from a monoplane glider, with which he was experimenting. The accident occurred at Evergreen, five miles from Santa Clara, California.

ELECTRICAL CONTRACTORS' NOTES.

Building is progressing nicely in Sacramento and Stockton and all the contractors are busy.

Paul Butte of the Butte Engineering & Electrical Company, has returned from a business trip to Oregon.

The wiring of the new Kahn garage on Sutter and Van Ness avenue, has been let for $2350 to a local contractor.

The members from San Jose Local No. 9 and Redwood Local No. 10 had a joint meeting October 23d. A pleasant meeting was held and trade conditions discussed until a late hour.

The John G. Sutton Company were awarded the wiring and steam heating contract for a seven-story building on the corner of Seventh and Market streets, belonging to Mrs. Jos. Dupuy, for $5750.

The wiring for the new theatre of the Downtown Realty Company, on Mason and Eddy streets, was awarded to A. E. Brooke-Ridley for $8450. The terms of the contract are that part of the payments are to be taken out in bonds. The bids ranged from $8450 to $13,000.

G. H. Duffield, special representative for the National Electrical Contractors' Association, left on the Lark Thursday night, after a very successful ten days in this part of the State gaining many new members for the National and assisting the State officers greatly.

Bids are being taken for the Odd Fellows' new home at Saratoga, near San Jose. The electric work will run close to $1500. A complete system of Electric lighting and telephones, also one of the most complete systems of fire alarms that has ever been installed is included.

NEW CATALOGS.

The Pacific Electric Heating Company has published the October issue of "Hot Points," which is gotten up in its usual attractive and interesting style, dealing largely in subjects akin to electrical heating.

Descriptive leaflet 2378, covering Rotary Converters for Railway Service, has just been issued by the Westinghouse Electric & Manufacturing Company. Under each picture is given a short description of the method of construction of the part illustrated.

Holabird-Reynolds Co. has just issued catalogue No. 2 on electrical supplies. The catalogue contains 310 pages and the handsome and attractive manner in which the book is gotten up is a credit not only to the company interested, but is a compliment to the progress of the electrical trade on the coast.

The Westinghouse Electric & Manufacturing Company has issued circular 1131, describing Graphic Meters for Switchboard Service. The publication shows illustrations of the meters together with typical charts taken from same, indicating the various uses to which graphic meters may be put with advantage to the user.

The Okonite Company, 253 Broadway, New York City, has published an attractive booklet entitled "Economy in Joint Making, With Instructions." It contains information which should be very much in demand just at this season of the year, as now is the time to make repairs in the way of insulating and protecting joints so that short circuits, with their accompanying troubles, may be avoided during the winter to come. Copies of the booklet can be secured on application to The Okonite Company.

In its folder No. 4186, dated September, 1911, the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., describes an auxiliary line switch for use on trolley cars equipped with ordinary drum type controllers. Westinghouse Railway Equipment is the title given by the company to its folder No. 4184, dated September, 1911. This is an art folder, time table size, and it has a very attractive cover. Descriptive leaflet No. 2371, dated August, 1911, treats of the Type O engine driven, direct current interpole generators, manufactured by that company. The leaflet is letter size (9 in.x11 in.), and is arranged to bind in with correspondence.

MEETING NOTICE.

The broad-gauged men in the electrical industry are coming to realize more and more not only the value of co-operation in the electrical industry but the vital necessity for it. This fact was strongly brought out at the last annual meeting of the Sons of Jove, held at Denver, Colorado, 16-18th of October, and a number of suggestions made for practical co-operative work that could be carried out by the Jovian order.

Probably one of the most valuable movements which has been inaugurated in the electrical industry since its inception was the organization of the commercial section of the National

Philip S. Dodd.

Electric Light Association which, through the work of its various committees during the past year, has gone a long way toward proving the value of co-operative work.

Philip S. Dodd, the secretary of the Commercial Section of the National Electric Light Association, will be in San Francisco during the coming week and there is a movement on foot to hold a luncheon on Tuesday, the 7th of November, which will be attended by electrical men from every branch of the industry. Mr. Dodd has been invited to tell us at that time of what co-operation has done and what its possibilities may be.

BASEBALL GAME

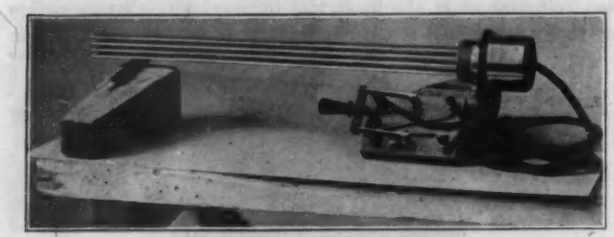
The baseball game at Golden Gate Park playgrounds last Saturday between the teams of the Pacific Gas & Electric Company and the General Electric Company was a great success. The score for the seven innings played, was 13 to 12 in favor of the General Electrics. There was a large turn out of representatives of both corporations, who rooted for their respective players. T. E. Bibbins gave satisfaction as umpire. The lineup was as follows: General Electrics—Shreve first base, with Fulton as alternate; Alvord second base; Hunt, third base; Jollyman, catcher; Jones and Gracia, pitchers; Laingor, shortstop; Boyd, right field; Patterson, center field; Wheeler, left field. Wheeler distinguished himself by going to the bat five times, making three hits, three runs and two stolen bases.

Pacific Gas & Electric—Rogers, first base; Lisberger, second base; Varney, third base; Cain and Lusk, pitchers; Mensing, catcher; Bostwick, shortstop; Bridges, right field; Henley, center field; Keppelman, left field. Mensing was at the bat twice and made two three-baggers. The best hitting was done by Frank H. Varney, who made four hits. A return game will be played.

INDUSTRIAL

ELECTRIC OIL HEATER.

The use of electric immersion heaters in the transformer and switch oil supply tanks of the Nisqually power development of the City of Tacoma, Wash., is perhaps one of the most novel of the recent industrial applications of electric heating. Mr. H. F. Gronen, chief engineer of the Nisqually project, has authorized the Seattle office of the Westinghouse Electric and Manufacturing Company to furnish their bayonet type of heaters for the tanks at the La Grande plant and at the Tacoma substation.



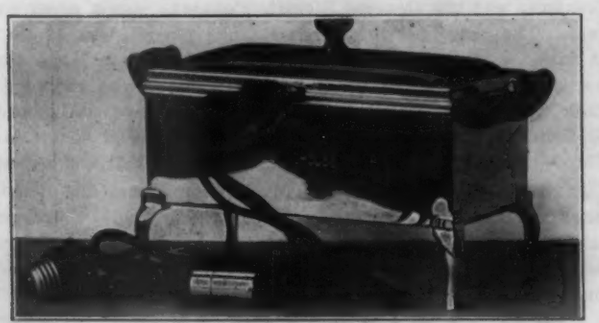
New Type Electric Oil Heater.

For the transformer oil tanks the order calls for three 24 in. bayonet heaters, each having a maximum heat input of 3 kw. and provided with a series-parallel switch giving six different heat combinations. The oil switch tanks will be equipped with three 12 in. 1½ kw. heaters with similar switches. The wiring is arranged so that the load on the three-phase bank of transformers will be balanced on the different phase, one heater being connected across each phase for each bank.

The heating element consists of slotted resistance ribbon incased in a mica insulated sheath and the whole inserted in flattened copper tubes. These tubes are sealed at their ends and are brazed into a capped casing. On these pipe plug castings are mounted the terminals for making the outside connections. As the whole unit consists of nothing but metal and mica, there is very little danger of mechanical damage or breakage of parts due to sudden changes in temperature. This construction is such that any length heater up to the limit of mechanical strength may be supplied on almost any voltage up to 250 volts.

THE WESTINGHOUSE INSTRUMENT STERILIZER.

The psychological effect of sterilizing instruments in the presence of the patient is rapidly becoming recognized by physicians, dentists and hospital attendants, therefore the advantage of having at hand a convenient and ready method of sterilizing is apparent to all.



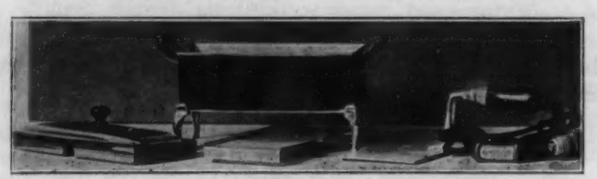
New Electric Instrument Sterilizer.

Instruments may be perfectly clean and disinfected but the mere fact that the operation of cleaning them is done before the eyes of the patient goes a great ways towards putting them in a more satisfied frame of mind.

The sterilizer described below enables this to be done in a very convenient and inexpensive manner.

The device consists essentially of the vessel for the instruments and the separable heater element with its attachment plug, cord, and switch.

The dimensions of the sterilizer permit the use of instrument trays which are similar to the standard design and can be lifted out by means of the handle of the heating element which is always cool. This construction obviates the inconvenience of using forceps or other instruments for removing the trays, a feature of particular advantage to a person using a sterilizer while engaged in other duties.



Sterilizer in Sections.

The heater element is of the well-known Westinghouse immersion type, and is placed within the instrument vessel containing the water. It is supported a short distance from the bottom by flanges on the sides of the perforated metal tray, thus allowing free circulation of water above and below.

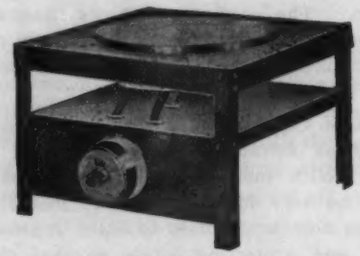
The heater is equipped with a substantial wood handle having an ebony finish which serves as a means of lifting out the instrument tray. The handle is always cool and its finish adds to the attractive appearance of the sterilizer.

The cost of operation, is practically negligible as it is only necessary to run it on the high heat for a very short time and then switch to the low heat.

The sterilizer is manufactured by the Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

NEW ELECTRIC HOT PLATE.

The new 8-inch disk stove now being placed on the market by the General Electric Company is designed for use in readily increasing the capacity of the kitchen equipment of hotels and restaurants, and also for use in carpenter shops, binderies and other manufacturing establishments requiring a high power rapid heating hot plate free from the inherent dangers of gas plates.

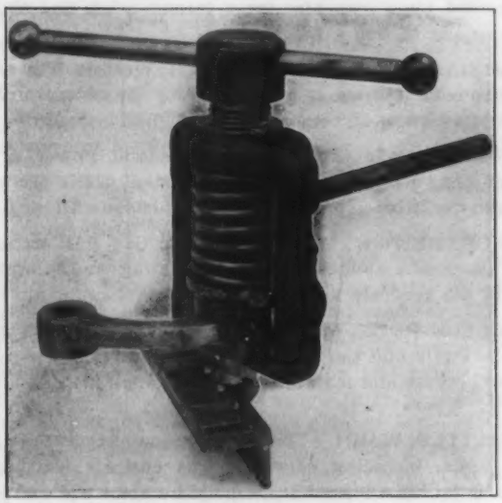


A New General Electric 8-Inch Disk Stove.

The stove is provided with a heating element of Calorite, and a three-heat indicating switch serves to give 375, 750, and 1500 watts heat dissipation on 95-128 volts, or 300, 600, and 1200 watts on 200-250 volts.

CONNECTOR PULLER FOR DISCONNECTING CELLS OF "EXIDE" VEHICLE BATTERIES.

The individual cells in the various types of "Exide" Batteries are joined together by connectors integrally burned to the strap post. This burned connection is the most positive and satisfactory. When one or more cells have to be cut out, it has heretofore been customary to do this in one of two ways: either loosening the connector by putting a flame on the burn, over the post, or boring through the burn with a brace and bit.



New Electric Connector Puller

The Electric Storage Battery Company has now perfected a connector puller, a device which mechanically uncouples the connectors by shearing, leaving both post and connector in perfect condition for reburning. In order to accomplish this, it is necessary that the plunger which does the shearing be very accurately aligned and centered. This connector puller has been so designed that the centering is done in a very positive manner, and the connector **must** come off true.

Connector Puller in Place

The connector puller fits the pillar strap of all types of "Exide" cells, including the "Ironclad-Exide," and is manufactured in two sizes. One size, No. 8879, fits all cells corresponding to the 13 plate "Exide" (5 inch jar) and smaller; while the other No. 8880, fits those corresponding to the 15 plate "Exide" (5¾ inch jar) and larger.

The two illustrations, showing the puller alone and in place ready to work, make clear the method of operation.

WESTINGHOUSE EXHIBIT AT ATLANTIC CITY.

Among the interesting exhibits made by the Westinghouse Electric & Manufacturing Co. held at the Atlantic City Convention of the American Electric Railway Association was a complete equipment of the 1500 volt, direct-current control system. The exhibit also included a No. 321, 75 to 90 horsepower motor for operation on 1500 volt direct-current. Also a 1500 volt dynamotor and compressor was in operation. In the design of the latter machine a radical departure from standard practice was made. This compressor will prove particularly effective on 1200 and 1500 volt systems for the reason that it reduces the voltage for the control and lights, and at the same time operates the air compressor when it is actuated by the governor. Therefore, it also eliminates the use of a special motor compressor for 1200 or 1500 volt equipment.

The well-known Westinghouse Type HL Unit Switch Control was also exhibited in actual service, connected to two motors rigged up with a pony brake.

Exhibits were also shown of single-phase railway motors and interpole direct-current railway motors together with a complete line of detail apparatus, such as controllers, circuit-breakers, commutators, resistors, and trolley line material.

The company was well represented by a considerable number of the officials and salesmen, among whom were President E. M. Herr, Vice-President L. A. Osborne and C. A. Terry, H. P. Davis, Sales Manager S. L. Nicholson, Manager of Railway and Lighting Department C. S. Cook, Manager of Detail and Supply Department G. Brewster Griffin, Manager of Department of Publicity J. C. McQuiston; F. N. Kollock, manager Seattle office; S. J. Keese, manager of Los Angeles office, and T. J. McGill, manager of Atlanta office.

ELECTRIC EQUIPMENTS IN A NEWSPAPER PLANT.

The New York Globe has recently installed an interesting electric equipment in its new plant at Washington and Dey Streets, New York, which is one of the most complete and modern installations of its kind. On the first floor are three high speed sextuple presses capable of turning out 36,000 24-page papers per hour, and two standard speed sextuples, which turn out 24,000 papers of the same size. These presses are all driven by Sprague Electric Motors and operated by the Kohler full automatic system of printing press control. The motors for the high speed presses are 60-horsepower and have an operating range between 18,000 and 36,000 papers per hour entirely by field control, that is, without any unnecessary loss or waste of current. For threading in the web the cylinders are turned over at ten revolutions per minute by a 10-horsepower motor, which is connected to the drive shaft of the large motor through double reduction spur gearing. The two standard speed presses are driven by a combination of 50 and 10-horsepower motors.

TRADE NOTES.

Frank H. Ray, who recently sold his electric power interests on Rogue River to the Siskiyou Electric Power and Light Company, is at San Francisco from the new prospect hydraulic plant

The General Electric Company has sold to F. C. Roberts & Co., contractors for installation in the new San Francisco City and County Hospital, four C. C. 4, 125 kw., 2400 r.p.m., 125 v., 250 v., three-wire, non-condensing Curtis turbine generating sets. Also a switchboard of eleven panels.

The American Electrical Works has closed a contract with the San Francisco Department of Electricity for weather proof and bare copper wires covering the municipal requirements during the ensuing year. This sale was negotiated through the Pacific Coast agents, the Telephone-Electric Equipment Company.

NEWS NOTES

INCORPORATIONS.

ABERDEEN, WASH.—The Mutual Heat & Light Company of Aberdeen has been incorporated for $50,000, by W. Mack and M. Snyned.

LOS ANGELES, CAL.—The West Coast Gas Light & Fuel Company has been incorporated for $75,000, by W. J. and J. McGimpsey.

DELANO, CAL.—The Delano-Linns Valley Telephone Company has been incorporated for $10,000, by Ben Thomas, J. C. Rutledge, A. Villard, P. Girard and R. W. Lockridge.

FINANCIAL.

LOS ANGELES, CAL.—Judge Wellborn has found for the defendant in the action brought by the Los Angeles Gas & Electric Company against the Western Gas Construction Company of Fort Wayne, Ind., to recover $28,323.45 alleged to be due on a breach of contract in the sale of water-gas apparatus. He found for the plaintiff on the cross-complaint of the defendant asking judgment for $18,210.95. Under this ruling the Los Angeles corporation must pay the balance of $6,667.55, due on the original price of $35,000 for the apparatus. Each side must pay its own costs.

SAN FRANCISCO, CAL.—The stockholders of the Pacific Gas & Electric Company at meetings held at the company's offices in this city, authorized the creation of a new mortgage upon the company's properties, under which it may, from time to time, as required, issue its bonds to the maximum amount of $150,000,000. This new bond issue will provide the means for refunding or retiring at maturity, or as occasion may arise, all of the existing bond issue of the Pacific Gas & Electric Company and of subsidiary and controlled corporations. At this meeting the stockholders also approved an increase in the common stock of the company to $150,000,000, this being also the amount of the new mortgage which was authorized. The company does not contemplate the immediate issuance of any of this stock, the action of the stockholders in authorizing the increase having simply been taken to enable the company to comply with the California statute under which no California corporation may have outstanding indebtedness in excess of its subscribed capital stock.

BLUE LAKE, CAL.—There has been a serious break in the negotiations by the Western States Gas & Electric Company of Eureka for the purchase of the local electric light system, owned and operated by the Minor Mill & Lumber Company of Glendale and for the time being, at least, the deal is off. Report has it that Manager H. L. Jackman of the Western States Gas & Electric Company has agreed upon a purchase price for the system with I. Minor but that when it came to signing the papers Minor raised the price by several thousand dollars and was abrupt'y turned down. Mr. Jackman was at Glendale several days ago arranging the deal with Mr. Minor and at that time Minor stated that the transfer would probably take place within the next few days. He now refuses to say anything, except that the negotiations are at an end, at least for the present. It is said that the Wesern States Company made its final bid, which was somewhat less than the price finally asked by Minor and that there will be no transfer unless the latter comes to terms. The Blue Lake lighting system, with a power plant at the Glendale mill of the Minors, is the only independent system in the county at present, the Western States Company having within the past year acquired the systems at Arcata, Fortuna and Ferndale.

TRANSMISSION.

FOREST, CAL.—The North Fork mine is making surveys and estimates of cost for the installation of an electric light and power system.

SAN JOSE, CAL.—The Great Western Power Company has applied for a franchise for a transmission line along the county roads of Santa Clara county.

SACRAMENTO, CAL.—The Great Western Power Company has been granted permission to lay an underground wire system on certain streets of this city.

DORRIS, CAL.—The Siskiyou Electric Power & Light Company has a large force of men engaged on the preliminary work for the extension of its lines to this town.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has made application for a lighting and power franchise in the recently annexed sections of Sacramento.

CASTLE ROCK, WASH.—The City Council has granted to H. B. Davis and the Tacoma Investment Company, a franchise to operate and maintain an electric power system in this city.

SEATTLE, WASH.—The power house of Schwager & Nettleton mills, including contents, was entirely consumed by flames, entailing a loss of $25,000. The plant will be replaced at once.

Portland, ORE.—General Manager O'Brien states that work of electrifying the west side of the Southern Pacific railway will start as soon as orders to that effect have been received from headquarters.

STOCKTON, CAL.—The city is planning for the installation of a municipal underground conduit system in the business district, to be rented to the private companies. An election for this issue will be held November 7.

SEATTLE, WASH.—The plans and specifications prepared by the B. P. W. providing for constructing the first section of a municipal street railway were approved by the city council and bids have been ordered advertised for.

BERKELEY, CAL.—The Sierra and San Francisco Power Company is planning for the installation of a power and lighting system at Berkeley. No franchise is required for this work and the City Council has been notified of the intentions.

SALEM ORE.—It is rumored that an electric line will be constructed between this city and Stayton. It is further reported that an official of the Portland, Eugene & Eastern road is negotiating with the Eugene council regarding franchises, etc.

TULARE, CAL.—The Tulare County Power Company has awarded a contract to Hunt, Mirk & Co., San Francisco, for he installation of a 3000 h.p. steam-turbine generating plant at Tulare. Construction work on a distributing system will soon commence.

BEAUMONT, CAL.—C. H. L. Ghriest, owner of the Newport Beach Electric Light & Power Plant, has been here looking over the town with a view of establishing a plant here. He will furnish light and power and establish in connection a steam laundry and ice plant.

STOCKTON, CAL.—The Sierra and San Francisco Power Company plans for the installation of a distributing system at Stockton, with underground conduits in the business section. An auxiliary steam generating plant will be erected to serve the city. The company has commenced construction on a transmission line from Manteca to Stockton.

EVERETT, WASH.—It is reported that the Stone & Webster interests are preparing the installation of a power plant in Sultan Canyon. Fourteen hundred acres of land have been secured from the government and a 200-foot dam is to be constructed above the narrow gorge.

SACRAMENTO, CAL.—President T. T. O'Gregory of the Sacramento-Woodland Railroad, has awarded a contract to the Dozier Construction Company for the construction work of the line between Woodland and Elkhorn, and to Cooper and Hawley for the construction of another section.

HELENA, MONT.—The United Missouri River Power Company, which owns Canyon Ferry, Hauser Lake and the uncompleted Holter hydraulic plants on the Missouri River, has gone into the hands of a receiver on request of the United States Mortgage and Trust Company of New York, which holds a bond of $12,500,000 of the company's.

McMINNVILLE, WASH.—The County Court has granted to the Yamhill Electric Company the right to set up poles and string wires along the Dayton-Portland road from the corporate limits of Newberg easterly to the county line, and along all other public roads leading from and into Newberg for a distance of three-fourths of a mile outside of said limits.

PORTERVILLE, CAL.—C. H. Holly, chief engneer of the Tulare County Power Company, is quoted as saying that the company will be delivering power to the patrons of the line not later than April 1, 1912. The substation for the orange district will be located at Strathmore, and a site has been secured in Tulare for a station which will supply the dairy district and where a steam auxiliary will be located.

PORTLAND, ORE.—Philadelphia capitalists, it is announced, will shortly start construction of an electric railway between Canby, Ore., and Portland with a system of feeders to affect the country tributary. The enterprise includes the drilling of a tunnel under the hills back of Portland, and a subway to have a teminus in the heart of the city According to estimates submitted by engineers the project will aggregate a cost of $5,000,000.

BAKERSFIELD, CAL.—By November 1 the Weed Patch district lying southeast of Bakersfield, will be supplied with electric power by the San Joaquin Light & Power corporation. Right of way is now being secured and parties who have contracted for power have been assured it will be available within a very few weeks. Power will be brought from the main line at Edison via a main Weed Patch line about 14 miles. Power is to be supplied at the rate of $50 per h.p. per year. Among those who have already contracted for power is H. F. Seat who has 800 acres in the heart of the Weed Patch and who has ordered a 20 h.p. motor to supply the tract with water. The Foothills Citrus Colony with 480 acres has contracted for 480 acres and Mr. Moore will also operate his pumping plant with electric power. Mr. Seat states that land values in the Weed Patch now worth $50 per acre without water and $100 per acre with water, will, in a year or two, advance to $75 for barren land and $150 per acre for land well supplied with water.

SAN FRANCISCO, CAL.—According to President James W. Goodwin of the Oro Electric Corporation, his company has made preliminary plans to build a power plant on the Feather River about 40 miles north of Oroville and to extend its power lines through Oroville and Marysville into Sacramento and eventually into Oakland and the bay cities. The Oro Water, Light & Power Company, a subsidiary concern, now furnishes electric light and power to the city of Oroville, maintaining a power plant on the river near that city. The parent corporation owns a valuable power site further up the river, and it is in the development of this site and the erection of a plant there that the first money derived from the sale of the bonds will be expended. The Oro Electric Corporation was organized last March with a capital of $10,000,000, of which $7,500,000 is said to have been subscribed. A few weeks ago official notice of the authorization of a bonded indebtedness of $10,000,000 was filed. The bonds to be issued will carry 6 per cent interest and will run for 40 years. James W. Goodwin, president of the company, holds 74,940 shares of the stock. The other directors are James K. Moffitt, J. D. Galloway, F. A. Benicke, W. S. Wilsey, F. S. McAllister and W. G. Jack.

TRANSPORTATION.

PORTLAND, ORE.—The Oregon Electric Railway is double tracking its line through this city.

COTTAGE GROVE, ORE.—It is reported that the Oregon Electric Railway will consider the proposition of constructing an electric railway system here.

NANAIMO, B. C.—A communication was received by the British Columbia Hydraulic Company of Victoria regarding the installation of a tramway system.

PORTLAND, ORE.—Franchise has been granted Hartman & Thompson, Chamber of Commerce Building, to construct a street car line on Sandy road, from the city limits to Parkrose.

LOS ANGELES, CAL.—The Pacific Electric Company is planning to have the Inglewood avenue and Hawthorne lines to Redondo Beach standardized; also the narrow gauge line to San Pedro.

EUGENE, ORE.—McDougall & Guthrie, who have the contract for grading the Oregon Electric railway right-of-way between Albany and Salem, are reported as also having secured a similar contract on grading the company's line between Eugene and Albany.

FRESNO, CAL.—The bonds of the Fresno, Hanford & Summit Lake Interurban Railroad Company have at last been taken over by the Philadelphia underwriters, according to a telegram received in Fresno from the attorneys of the railroad company in New York.

MONTEREY, CAL.—An order for the rails necessary for the completion of the Monterey and Seaside street railway has been placed and the intention of the owners, the Phelps Company, is to at once commence operations for the finishing of the road and placing it in operation.

HEALDSBURG, CAL.—It is reported on good authority that during the coming year the line of the Petaluma and Santa Rosa Electric Railway will be extended to Healdsburg. A bond issue has been negotiated with well-known Eastern capitalists to finance the building and equipment of the road.

SEATTLE, WASH.—The Highland Park and Lake Buren Railway Company has been incorporated and proposes to build an electric railway from First avenue south at Ox Bow to Lake Buren. Later the incorporators will push the line on to Tacoma. The trustees of the corporation are W. H. Murphy, F. W. Dashley, Dr. D. Burkhart, Geo. White, Chas. Schoening and others.

OAKLAND, CAL.—Plans calling for a two-story modern concrete and steel power storage plant to be erected at the Melrose terminal of the Seventh street local at the cost of $30,000 have been accepted by the local officials of the Southern Pacific Company and work will be started at once in an effort to have the plant ready by the forepart of November, when the local system will be turned into an electric line.

OAKLAND, CAL.—An application for a street railway franchise beginning at the intersection of the north boundary line of the city of Berkeley with the center line of the Arlington road to its intersection with the northern boundary

line of the county of Alameda, was made Monday by the Oakland Traction Company at a meeting of the Board of Supervisors. A 50-year franchise is asked for, which is practically an extension of the Euclid avenue line. The application was referred to the franchise committee.

FRESNO, CAL.—Assurances have been received by the Fresno, Hanford & Summit Lake Railroad Company that within the next day or so the first shipment of rails for the interurban line from Fresno to Kingsburg and Sanger, will be made. It is expected that the laying of rails will start November 15. H. A. Hansen, who has just secured the contract for the concrete and pile bridge work of the road will begin work this week. Everything is in readiness and it is not expected that there will be any delay.

SACRAMENTO, CAL.—Franchises have been granted to the Pacific Gas & Electric Company by the City Trustees to extend the street car lines through the city in four new sections, the company being the only bidder for the privilege. It is to pay 2 per cent of the gross receipts annually after the first five years. The four sections were: On T street from Twenty-eighth to Thirty-first; on Third from J to I and west to Second; on E from Thirty-first to Seventh, and thence to G; on K from Fifteenth to Twenty-first, and thence to P.

VANCOUVER, WASH.—Lawrence Harmon, who was recently granted a franchise for the construction and operation of railway lines over certain streets in this city, in a statement announced that the sum of $3,000,000 would be expended in Vancouver, Clarke and adjoining counties on development work. Suburban railway lines and feeders will be built, water power developed and townsites will be established. The franchise provides that work on the local electric railway system start before April 1st and 1½ miles of track is to be in operation by April, 1913.

EMERYVILLE, CAL.—Active work has been started on the erection of the $200,000 plant of the Westinghouse Pacific Coast Air Brake Company, affiliated with the Westinghouse Air Brake Company of America, at Park avenue and Halleck street. The officers of the new Westinghouse Pacific Coast Air Brake Company are: H. H. Westinghouse of New York City, president; S. G. Gown of San Francisco, vice-president; H. S. Clark of Berkeley, second vice-president; A. L. Humphrey of Pittsburg, general manager; S. N. McMunn of Oakland, secretary and auditor, and F. C. Mortimer of Berkeley, treasurer.

ILLUMINATION.

SEATTLE, WASH.—Municipal light extension bonds in the sum of $1,000,000 were authorized to be advertised for sale.

FLORENCE, ORE.—The proposition of granting a franchise to the Oregon Electric Company here was voted down at a recent election.

LA MESA, CAL.—The San Diego Consolidated Gas & Electric Company will soon commence the laying of its gas mains from City Heights to La Mesa.

VICTORIA, B. C.—Bids will be received by the purchasing agent up to November 3rd for furnishing 2,600 12-inch R. I. globes and 100 14-inch globes for the lighting system.

SNOHOMISH, WASH.—The City Council has authorized the Mayor and City Clerk to enter into a lighting contract with the Everett Gas Company for a period of ten years.

CASTLE ROCK, WASH.—H. B. Davis, J. W. Selden and the Tacoma Investment Company have received a fifty-year franchise and a five-year contract to furnish this municipality with lights.

AUBURN, WASH.—The country around Auburn will have the advantage of gas for heating and lighting if the franchise applied for by the Seattle Lighting Company of Seattle, is granted.

MARYSVILLE, CAL.—The Butte Construction Company of San Francisco has been awarded the contract for seven arches to be used in lighting the business section of Marysville. The bid was for $6100.

OAKLAND, CAL.—Alfred Olson and fourteen other residents and property owners in Castro Valley, have petitioned the board to install street lights in the valley on the Dublin road and on the Redwood road.

LYLE, WASH.—As the result of a ruling of the Superior Court, the Northwest Electric Company is given a right to condemn property for right-of-way purposes. Work will be resumed at once on the $1,000,000 water power project on the Klickitat.

SAN DIEGO, CAL.—Normal Heights, a suburb of San Diego, and City Heights, an adjoining suburb, have voted to install street lights. Normal Heights will install sixteen arc lights on Adams avenue and City Heights will install sixty arc lights.

SUMAS, WASH.—At the council meeting the bid of the Cascade Trading & Construction Company, in the sum of $772.50, for the erection of electric light poles, was accepted. The bid of the Western Electric Company in the sum of $2717.54 for the construction of electric wire for construction of a light system was also accepted.

MONTESANO, WASH.—T. H. Minear of Tacoma is superintending the installation of foundations for the new power house to be erected at the plant of the Montesano Light and Power Company, north of the city. The structure will be two stories in height, 30x40 feet, of concrete construction, and will be completed within 60 days. The Pelton-Francis turbine pattern engine, to develop 315 h. p., will be installed, and two Westinghouse pattern 100-kilowat capacity are specified.

TELEPHONE AND TELEGRAPH.

ALBANY, ORE.—The Pacific States Telephone & Telegraph Company have asked the city of Harrisburg for a franchise.

CHEHALIS, WASH.—Application has been made by J. Y. Coffman for a franchise to operate a telephone system in the city of Chehalis for fifteen years.

HAMILTON, MONT.—The Flathead Independent Telephone Company, capital $50,000, has been incorporated by A. H. Stephens, V. H. Calhoun and F. C. Wilhelm.

TEKOA, WASH.—Mr. Gray representing the Pacific States Telephone & Telegraph Company, has asked for a franchise to erect and maintain a telephone system for a term of 25 years.

ASTORIA, ORE.—The Court has granted a franchise to the Centennial Telephone Company to operate their telephone line over the county roads and set the necessary poles between Elsie and Jewell.

EUREKA, CAL.—Through the co-operation of the United States Forest Service, the Hoopa Indian Agency and the California Mining & Dredging Syndicate at Orleans, and Upper Klamath River and Hoopa section will soon be connected by telephone with the outside world.

PASCO, WASH.—An ordinance calling for the purchase of the city waterworks system of the Pacific Power & Light Company at the figure of $46,000 and which was vetoed by Mayor Captain Gray, two weeks ago, has been passed by the City Council over the mayor's veto.

CHELAN, WASH.—At a meeting of the Eastside Telephone Company arrangements were made for rebuilding the company's telephone line the coming fall.

FLORENCE, ORE.—At a recent election the proposition of granting a franchise to the Florence-Mapleton Independent Telephone Company to erect and maintain poles and wiring was voted down.

STANFIELD, ORE.—The City Council of Stanfield has passed an ordinance granting to C. P. Bowman a franchise for the construction of a telephone exchange and long distance lines for a period of 25 years.

EUGENE, ORE.—The Pacific Telephone and Telegraph Company will soon commence construction of a new line between Eugene and Cottage Grove. The company will also extend and improve its systems at Roseburg and Albany. About $75,000 will be expended in this work.

SALMON, IDA.—It is reported that the Lemhi Telephone Company, in which President W. A. McCutcheon is largely interested, will extend its line sixty miles down the river. This is taken as an indication that the Gilmour & Pittsburg will start railway construction work next spring.

WALLA WALLA, WASH.—C. P. Van Houtte, district commercial superintendent of the Pacific Telephone & Telegraph Company, announces that toll line improvements in this district will entail an expenditure of $80,000. The work will be under the direct supervision of C. H. Pfleeger, and consists of the following: $1,000 for a new additional toll line between this city and Touchet; $17,220 for an additional line between Walla Walla and Colfax; $14,000 for a new line between Prosser and Wallula; $15,000 on new lines between North Yakima and Prosser; $30,000 for additional toll lines between Arlington and the state line points, and several hundred dollars each for installing a private exchange carrying 117 phones in the new Hotel Grand, the placing of two modern switchboard sections at Waitsburg, and minor improvements to be made in the local service.

WATERWORKS.

MARICOPA, CAL.—Frank Torpey, of the firm of Torpey & Jones, has appeared before the board with a request for a franchise for the putting in of a $100,000 water system.

REDMOND, ORE.—The Council has recommended that immediate action be taken for the installing of a water system for the city, to be owned, operated and controlled by the city.

EXETER, CAL.—The entire plan of the new water system was gone over carefully with the engineer, Mr. Sloan, a few changes made of minor importance and the plans accepted.

YERINGTON, NEV.—The City Council has accepted the bid of the American Light & Water Company of Chicago, which company bid to construct the water system for $31,940, and take the bond issue at par.

PORTLAND, ORE.—The city water board has ordered the construction of a large feeder water main from Division street south to the heart of the Sellwood district. The estimated cost of the main is $129,000.

TWISP, WASH.—At the regular meeting of the council the question of installing a water system for the town took a turn in its favor. The city attorney was instructed to draw up an ordinance for bonding the town to raise $12,000.

PRUSSER, WASH.—Upon motion of T. E. Brockhausen the city attorney has been instructed to prepare an ordinance calling for a special election to decide whether or not the city will vote bonds to construct a domestic water system to cost $48,000.

VICTORIA, B. C.—Bids will be received by the city clerk of Prince Rupert, B. C., on or before November 20th for the supply of approximately one thousand, eight hundrd tons of cast iron water pipe; 38 tons of special castings, and a quantity of gate valves, valve boxes and hydrants.

RENO, NEV.—The new power company has completed its surveys for power sites and ditches from the Truckee River east of Reno. The work of building the power plants will soon commence. This company has two power sites and intends to install plants that will generate electricity up to 9000 h.p.

POCATELLO, IDAHO.—A special bond election will be held in the Gate City to afford qualified electors who are taxpayers an opportunity to vote on the question as to whether or not there shall be issued $270,000 worth of 20-year bonds, to acquire by purchase, construction or otherwise, a municipal water system.

KLAMATH FALLS, ORE.—Ex-postmaster R. A. Emmitt, who was engaged by the city at an expense of $281.30 to investigate water sources for purer water system for Klamath Falls, examined a number of proposed sources, of which he concludes the best is Sun Creek, altitude 200 to 600 ft. with 5,000,000 gallon flow of water per day. About 3 miles of pipe would be necessary.

RICHMOND, CAL.—The case of the Peoples Water Company vs. the City of Richmond will be erased from the court calendar by a compromise, according to a statement of City Attorney B. H. Griffins, at the last meeting of the City Council. The old rate of 35c per 1000 gallons will remain in force and the water company agrees to refund to the city $550 as excessive charges on fire hyrdants.

BAKERSFIELD, CAL.—The Western Water Company promises to have its plant and pipe line in readiness for delivering water to its customers in the vicinity of Taft about November 15. The company already has its pumping plant installed on the flat near Button Willow, and excellent progress is being made in laying the pipe line. The water is to be piped to two hills, and distributed thence by gravity to the companies operating on Twenty-five hill and elsewhere in the Midway field. Service will be extended to North Midway about 15 or 20 days later. The deliveries about Taft will amount to approximately 15,000 barrels daily, but the system will have a capacity of 50,000 barrels daily. The water will come from artesian wells and will be forced through the pipe line by the power from two 250 h.p. engines. Only one engine is to be used at a time, however, the other being for emergency use to obviate the necessity of shutting down for repairs, a difficulty that has interfered with the service of some of the other water companies, that have furnished water to the West Side fields.

BERKELEY, CAL.—Water rates to be effective in this city for the ensuing year were fixed following a secret session between a representative of the People's Water Company and the City Council, at an executive meeting held in the office of Mayor J. Stitt Wilson, following which a public meeting was held and the arrangement made read in open meeting. As the result of this new schedule of prices made effective, residents of this city will pay the highest rate which has been in effect here for a number of years. The case has been before the U. S. Circuit Court, and, after a preliminary skirmish, steps were taken to effect a compromise. The agreement reached establishes a rate effective until July 1, 1912, of 35c per 1000 gallons with a minimum of $1.50 per month for householders' use; of 35c for municipal use; of $4 per month for each fire hydrant of four inches diamater or over; of $1 per month for small hydrants and of 30c for street sprinkling. The rates on which the suit was brought provided for a rate of 35c per 1000 gallons, minimum or $1.25; 35c for municipal uses; $3 for large and 50c for small hydrants, and of 30c for street sprinkling purposes.

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